ANNUAL REPORT

OF THE

STATE ENGINEER AND SURVEYOR,

ON THE

CANALS OF NEW YORK,

FOR THE YEAR 1862.

Transmitted to the Legislature January 23, 1863.

ALBANY:
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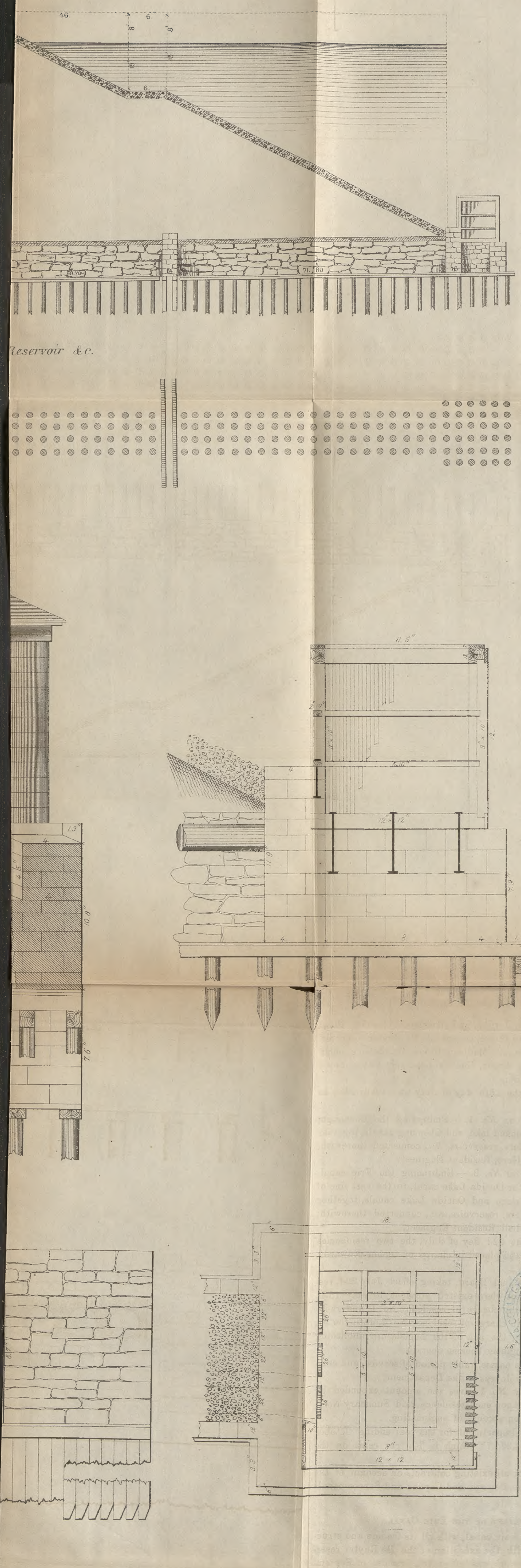
1863.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6
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Reservoir &c.
11.5"
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18

State of New York.

No. 50.

IN SENATE,

January 23, 1863.

ANNUAL REPORT

OF THE STATE ENGINEER AND SURVEYOR, ON THE CANALS OF NEW YORK, FOR THE YEAR 1862.

OFFICE OF THE STATE ENGINEER AND SURVEYOR,
ALBANY, *January* 23, 1863.

To the Honorable the Legislature of the State of New York:

I have the honor herewith to transmit to the Legislature my Annual Report on the canals of this State, for the year ending September 30, 1862.

Yours, respectfully,

WILLIAM B. TAYLOR,
State Engineer and Surveyor.

REPORT.

Office of the State Engineer and Surveyor,
Albany, *December* 10*th*, 1862.

To the Hon. the Legislature of the State of New York:

The State Engineer and Surveyor has the honor to submit his Annual Report on the New York State canals, for the fiscal year ending September 30th, 1862, as required by act, chapter 437, Laws of 1859.

The canals are in three divisions, corresponding to each Canal Commissioner's division, and are designated the Eastern, Middle and Western Divisions.

The Eastern Division embraces the enlarged Erie canal, from Albany to the Oneida Lake canal, at Higginsville, the Champlain canal, and the Black River canal, and River improvement.

The Middle Division embraces the enlarged Erie canal, from Higginsville to the east line of Wayne county, the Chenango, Oneida Lake, Oswego and Baldwinsville canals, the Oneida River improvement, the Seneca River towing path, the Cayuga and Seneca, Crooked Lake and Chemung canals and Cayuga inlet.

The Western Division embraces the enlarged Erie canal, from east line of Wayne county to Buffalo, and the Genesee Valley canal.

These divisions, during the last year, were in charge of division and resident engineers, up to September 1, 1862,

pursuant to act, chapter 105, Laws of 1857, (amended,) and during the month of September they were placed in charge of engineers and assistant engineers, pursuant to act, chapter 169, Laws of 1862.

Under the former act, the engineers were paid out of construction funds entirely, whereas, under the latter one, they are paid wholly from repair funds.

The appointments of the engineers under both acts, were made by the Canal Board, and their location and duties prescribed by the State Engineer and Surveyor.

For the number of persons employed on the canals during the last fiscal year, reference is made to the reports of the engineers on the divisions, which follow this report.

Previous to September 1, although a large amount of work connected with the repairs of the canals was performed by the engineers, no portion of the cost was chargeable to repairs, but wholly paid from construction funds, whereas by the act before noted, their work is confined to repairs (ordinary and extraordinary) and their expenses paid from repairs funds.

A large proportion of expenditures of the Engineer Department, for the last year, has been incurred in closing up the final accounts of construction work, as required by act, chapter 169, Laws of 1862, which act provides that all the work on the State canals, except that on the Champlain canal, should be declared completed on the 1st day of September, and that the final accounts should be rendered as soon thereafter as might be.

The Eastern and Middle Divisions of the Erie canal, and the Oswego canal, except two contracts, sections 24. 25, 26, and part of 27, and sections 22 and 23, are completed, but a considerable amount of work on the Western Division yet remains to be done.

The estimated cost to complete the Western Division, upon the plans heretofore adopted by the Canal Board, (not including constructing 13 enlarged locks between Clyde and Buffalo,) is, according to estimate of O. W. Storey, engineer in charge, $170,000.

There are about 75 miles of enlarged canal on the Eastern Division constructed with slope walls, resting upon benches, on an average $4\frac{1}{4}$ feet above canal bottom. This plan of canal gives only 42 feet width on botton of canal, and which will admit only of the passage of two loaded boats (with draft of $5\frac{3}{4}$ feet) at one time. The present plan of the slope wall extending to canal bottom and giving a width of 56 feet, will permit the passage of three loaded boats.

It can be readily seen that with the business which the canals have sustained during the past season, the navigation of this narrow and contracted portion of the canals lying at the eastern end of the State, towards tide water, must have been attended with many difficulties.

As boats approach tide water more particularly in the fall of the year, near the close of navigation and during the formation of ice, it is at times impossible to pass sufficient water into the lower levels to sustain a depth of seven feet.

It will be necessary to remove these slope wall benches and construct the canals upon the present plan of enlargement, before many of the difficulties upon this portion of the canal will be obviated.

I would call especial attention to the level between locks Nos. 1 and 2, at Albany, which is constructed upon the old bench plan; loaded boats cannot approach within about 18 feet of the top angle of the banks on either side of the canal. The distance between the locks is about 75 chains;

from the weigh lock to lock No. 2, the berme side of the canal is occupied by lumber yards, and sundry slips are connected with the canal; on the towing-path side, for one-half the distance, are iron manufactories, &c., located within a few rods of the canal, so that when two boats are unloading at the same time, opposite to each other, there is not sufficient capacity remaining for the third boat to pass.

Upon a petition of the Board of Trade and the lumber interest, in the city of Albany, a committee was appointed to examine the condition of the canal between lock No. 1, at Albany, and lock No. 3, at West Troy. They reported in favor of reconstructing the level from lock No. 1 to lock No. 2, upon the present plan of enlargement, with side walls extending to canal bottom; one-half the distance to be constructed with slope walls, the balance with vertical walls, at a cost of $27,000.

It would be a very desirable improvement if the canal for the entire distance between Albany and lock No. 3, should be constructed upon the present plan of enlargement, particularly that portion through West Troy.

The construction of an enlarged lock at lock No. 2, is desirable, and is required by the business upon the canal at that location. At present there is but one enlarged lock. The doubling of the locks would materially facilitate the passage of boats.

De Ruyter reservoir is left incomplete; the work on the reservoir was suspended on the first of September. The attention of the Legislature is respectfully directed to this piece of work, that provision may be made for its early completion. The long level between Utica and Syracuse has, several times during the last season, required an additional supply of water. The completion of this reservoir would be a valuable auxiliary in furnishing the deficiency.

The completion of Chub Lake reservoir (originally contracted for in 1851) would be of great service in insuring a constant supply of water to the Black River and Erie canals, in a dry season, as well as furnishing an additional quantity to the Black River improvement.

The attention of the Legislature will undoubtedly be called to the construction of a weigh lock at Oswego; the reasons and necessities for the structure are given in full in the annexed report of J. P. Goodsell, the engineer in charge.

I would call particular attention to the same engineer's report in reference to a recommended change in the prism of the canal, east of Lodi locks, on the long level. When the full capacity of the locks is tested (which is frequently the case) it is not possible to obtain a sufficient supply of water at their head to maintain the required seven feet. In my opinion the plan proposed would, with the water from De Ruyter reservoir, remedy the evil, and make the improvement for many years demanded.

The season of navigation just closed, has shown conclusively, to my mind, the necessity of constructing double locks on the Western Division, where single ones now exist. Numerous delays have been caused in consequence of the frequent inability to pass boats through the single locks as fast as they arrive. This was seriously felt in August last, after the breach at Knowlesville, it being weeks instead of days, before the crowd of boats which had accumulated during the repairs, could be disposed of. At that time, boats were loaded daily at Buffalo, sufficient in number to occupy the locks fully, without any addition, from the delay. A law authorizing their construction, should be passed as early as possible, during your present session, that proposals may be received in time to contract

for the work, so as to insure the delivery of all the materials necessary for their construction before the close of navigation in 1863, to the end that their completion and use may be realized at the opening of navigation in the spring of 1864. The estimated cost to construct the 13 single locks, (as per estimate of O. W. Storey, engineer in charge) is $412,000, and for guard lock at Black Rock, $35,000.

The Canal Board, in January, appointed a committee (on application of many citizens) to examine into the subject of constructing a weigh lock at Buffalo. Two reports were made, one for a lock to be located at Buffalo, to weigh loaded boats, and another to weigh light boats, to be located at Black Rock, near the guard lock. After deliberating upon the reports, both as to location and cost, and both for loaded and light boats, the board adopted a recommendation for the weigh lock for light boats. Below is the estimated cost to construct them:

Weigh lock for loaded boats at Buffalo	$80,000
do for light boats at Black Rock	22,000

The dam across the Genesee river, at the head of the feeder at Rochester, should be reconstructed. This feeder is very important in keeping up the water in the canal east of Rochester, when any breach or difficulty occurs west of that city. Since the original dam was washed away, its utility has been felt, especially during repairs of breaches on the western portion of our canals.

A concurrent resolution of the Legislature, at its last session, directed the State Engineer and Surveyor "to make an examination and survey of the Allegany river, from the termination and junction with the said river and the Genesee Valley canal, to the mouth of the Great Valley creek, past and near the crossing of the Buffalo and Brad-

ford railroad, and to report to the next Legislature the practicability of making such slack-water navigation and the probable cost of the same."

The survey was not made as directed, no funds having been provided to defray the necessary expenses.

Champlain Canal.

The locks located at Fort Miller, Moses kill and Fort Edward, should be reconstructed at the earliest practicable period; they are in a very bad condition. During this session, funds should be provided for their reconstruction.

Plans, estimates and locations have been adopted by the Canal Board. Two of the locks are so located (Moses kill and Fort Edward) that they could be constructed during the season of navigation, without retarding the opening of the canal, as in the case of rebuilding other locks.

Glens Falls Feeder.

Under act, chapter 213, Laws of 1860, it is required to "improve the Champlain canal and Glens Falls feeder, in such manner as to give in its entire length a uniform depth of five feet of water, and a uniform width of 35 feet on bottom, &c., and to stop leaks in Glens Falls feeder."

The Canal Board, in December, 1861, adopted a plan for improving and stopping leaks in the feeder. The plan provided for excavating the bottom of the feeder through the limestone ledges, where the leaks occurred, one foot, and replacing with concrete masonry, and the construction of vertical walls in cement, upon the sides of the feeder.

Large sums had previously been expended upon the feeder to prevent the leaks, but to no purpose, apparently. A portion of the work, under the present plan, has been completed and has thus far proved to answer successfully the designs of the projectors.

Chenango Canal.

During the last season a committee was appointed by the Canal Board, to examine the Kingsly Brook reservoir, and report its condition. The report stated that the lands in the reservoir, formerly flowed by water, are occupied by the heirs of the original owners, subject to the rights of the State. In two instances warranty deeds have been given, in each of which a reservation of the State's rights in the land is inserted.

The reservoir, as originally constructed, would furnish 93,812,000 cubic feet of water, but to construct as originally intended, would furnish 158,812,000 cubic feet.

The committee reported in favor of the reconstruction of the reservoir, and recommended that the Commissioner in charge notify the occupants of the land contained in the reservoir, of the action of the Board. The report was adopted.

Genesee Valley Canal.

It will soon be found necessary to take some action in reference to an additional supply of water on the Genesee Valley canal. At several points during the season of navigation just closed, a deficiency has existed, to wit: At Mt. Morris, Dansville, Oramel and the Cuba Summit. For detailed particulars in reference to each location mentioned, see O. W. Storey's report, annexed.

Documents accompanying the Annual Report on Canals.

Table No. 1, (following the reports of the engineers upon the three divisions) shows the number and compensation of engineers and employees in the Engineer Department of the New York State canals, together with incidental expenses for the fiscal year ending September 30, 1862.

Table No. 2, shows the length, in miles, number of

structures, character of work, estimated cost at contract prices, amount of work done during fiscal year ending September 30, 1862; whole amount done, including interest and work completed or settled, with the characteristic details of contracts existing during the year ending September 30, 1862, upon the New York State canals.

Table No. 3 shows amount of work done under supervision of the Engineer Department, on repairs under contract, and miscellaneous repairs upon the New York State canals during fiscal year ending September 30, 1862.

Table No. 4, shows number of section, names of contractors, length in miles, amount per annum, and location of repairs, sections under contract, on the New York State canals.

Table No. 5 is a statement of all the feeders to the Erie canal, together with the quantity of water furnished by each, per minute, during dry season.

Documentary Sketch of New York State Canals.

S. H. Sweet, Esq., Deputy State Engineer and Surveyor, has prepared a documentary sketch of the canals in this State, commencing at the earliest period of their history in this country and extending to September 1st, 1862, the date at which the canals were declared completed, by act, chapter 169, Laws of 1862. Considering the limited time of three months, allotted to the compilation of this report, it will be admitted that great credit is due Mr. Sweet for the valuable and interesting facts therein contained. A perusal of the document will show what close application and knowledge of the subject have been required.

Repairs of Canal by Contract.

The present system of letting the repairs of the canals by contract is not so effective in its operations as was

anticipated by the framers of the law under which it was authorized.

The original condition of the canals is not maintained, but on the contrary, nearly, if not every superintendent's section, after being under contract for a few years, is not in as good condition as it was while in the hands of the State officers. Having been for many years engaged upon the canals, both in charge of construction and repairs, my opportunities for observing the effect of the present system have given me a correct knowledge of its effects, and have led me to the opinion that a change should be made, whereby the canals could be kept in good condition and their structures maintained and preserved.

In my judgment the true policy of the State would be to adopt that mode of repairing the canals which would keep them in the best order at the least expenditure.

Perhaps it may be said that no plan can be adopted whereby these repairs may be performed for a less sum than the present one, but a system can be devised by which the canals may be kept in thorough order and their numerous and costly mechanical structures be perpetuated and preserved in that perfect condition which the interests of the State and of navigation demand.

In the present system there are many objectionable points which the one I intend to recommend will not include.

Repairs are now let for a gross sum per annum, for all work of whatever nature, that may be necessary to keep the canals in navigable order, so that the interest of the contractor is not to perform the work necessary for the well-being of the canals, but to do as little as possible, since all the outlay is sustained by himself, and all work remain-

ing undone, redounds to his profit, while the State sustains the loss.

As a consequence, most of the repairs, particularly of mechanical structures, are of a temporary instead of a permanent nature; this fact is well known to all who are in any manner familiar with the subject, and is constantly made the theme of comment by those who are deeply interested in the welfare and prosperity of our canals.

While this system is saving large sums to the State, it is also leaving equally larger ones yet to be expended, to render the canals in the same condition they held before being placed under contract.

It is not sufficient to say that the present system is stringent and covers all points, provided the contracts are literally and strictly carried out, for it is a fact beyond dispute, that no Canal Commissioner has yet been able to enforce all the provisions contained in the contracts, nor can he ever fully and practically do so, because the contractor's interests and that of the State are antagonistic, the one being anxious to do as little work as possible, while the other desires all that may be deemed necessary to maintain and keep the canals in proper navigable condition.

Another bad failure in this system is, that no two Canal Commissioners conduct their repairs in a similar manner, or construe alike the requirements of the contract.

The power of the Commissioner being absolute, each officer has full control, not only of the contract as relating to the work, but often of the contractor himself. The Contracting Board has no power except to advertise, let and abandon the contracts; the construction of them in all their provisions, rests wholly with the Commissioner in charge of the division upon which the contract may be located.

Out of this arises claims for all work done that may not be stipulated in the contract, and as the amount claimed by the contractor may not be paid by the Commissioner, recourse is made by the former to the Legislature, under whose enactments grants and awards are often made.

Claims of this nature should be avoided, or if possible, rendered as few in number as may be.

Under present regulations, the contractors are required to keep the canals in the same condition in which they were originally constructed; consequently, in cases where the banks were made too light to sustain the pressure upon them, or were constructed of materials not impervious to those leaks which have subsequently endangered navigation, the contractor does not deem it his duty to strengthen the banks or arrest the leaks without claiming extra compensation, and in that opinion he is correct. Consequently in many cases these necessary repairs are unattended to, or if undertaken, are construed by him as *extra work*, and are paid for as such. A reference to former reports will show heavy expenditures for this class of work.

In order to avoid the frequent claims made by the contractor, for change of plan in mechanical structures, &c., a law was passed at the last session, prohibiting any such change from being made, but the law does not reach the point, and in many cases prevents necessary improvements being made, even where a change of plan would be cheaper and better. The intention of the framers was in a measure correct, but the law does not carry it out.

In fact, the present system of letting repairs by contract is very faulty, and continually brings the Commissioner and contractor into collision as to the construction of the contract, the one claiming that the work done is covered by the terms of the contract, the other arguing that *extra*

compensation should be allowed. All such claims can be avoided and the necessary work be performed without the recurrence of these incessant and troublesome demands.

I recommend that a law be passed by your honorable body, authorizing the letting of canal repairs by contract, under regulations requiring that all work done, whether of earth, in its various classifications, or of stone, iron, wood, &c., be measured and paid for the same as in construction accounts; in this way the contractor will receive compensation for the actual amount of work done, and not be paid as at present, for work he does not perform.

By this method the canals can be kept in as good repair as it is possible to keep them, while all mechanical structures will be preserved and maintained at the lowest expense and thus attain the object desired. It must be admitted that the true economy and policy of the State call for the adoption of such measures in reference to repairs, as will maintain the canals in the best possible manner for the least outlay, as any sum less than one which will be sufficient for the payment of all necessary work, will not secure its performance. Very few if any of the repair contractors have suffered losses, although their contracts have been for sums less than one-half the fair compensation for such work, and in their appeals to the Legislature they usually succeed in obtaining such a construction of their contract as will include a large item of *extra work*.

Again, when directed by the Commissioner to do various kinds of repairs required by the contract, (and not complying with said requirements), all schemes are resorted to in order to prevent their contract being abandoned, while at the same time they are aiming to save the bond they

deposited with the Department as a guarantee for the due performance of their work.

An adoption of the above recommendations will avoid all such cases, and relieve the Legislature from the numerous claims yearly presented for *extra compensation*, arising out of the present system of letting repairs.

In my opinion such a law would insure a prompt performance of all work required, and as the contractor would only be paid for work actually performed, the canals would be kept in a condition alike favorable to navigation and satisfactory to the State, while every desirable object contemplated by repair enactments would be fully secured.

Respectfully submitted.

W. B. TAYLOR.

DOCUMENTS

ACCOMPANYING THE ANNUAL REPORT OF THE STATE ENGINEER AND SURVEYOR.

EASTERN DIVISION.

ENGINEER'S OFFICE, EASTERN DIVISION,
ALBANY, *October* 1, 1862.

HON. WILLIAM B. TAYLOR, *State Engineer and Surveyor:*

Sir—In accordance with the regulations established by your Department, under act, chap. 169, Laws of 1862, I have the pleasure of making the following

ANNUAL REPORT,

For the fiscal year ending September 30, 1862, for the Eastern Division of the New York State canals.

The canals embraced in this division are as follows:

	Miles.
Erie canal, from Albany to east bank of Oneida Lake canal	133.58
Albany basin	.77
Port Schuyler and West Troy side cuts	.35
Pond above Troy dam	3.00
Champlain canal and Waterford side cut	66.00
Glens Falls feeder and pond above dam	12.00
Black River canal	35.33
Black River feeder and pond above dam	12.09
Delta feeder	1.38
Improvement of Black river	42.50
Total, Eastern Division	307.00

There are also embraced in this division the following unnavigable reservoirs and feeders that supply water to the canals:

Reservoirs.

	Area of surface. Acres.	Average area. Acres.	Depth. feet.	Capacity. cubic feet.
Woodhull	1,236	1,118	18	876,550,000
*North Branch	423	277	28	310,000,000
South Branch	518	372	26	421,190,000
	2,177	1.767		1,607,740,000

*Can be filled twice during the year.

Feeders.

	Miles.
Mohawk feeder, upper aqueduct	0.39
Schoharie Creek feeder	0.63
Rocky Rift feeder	3.92
Mohawk, south side, Little Falls	0.19
Mohawk, north side, Little Falls	0.50
Mohawk feeder at Rome	0.05
Total length	5.68

The canals of this division have constituted one residency, and been in charge of W. B. Cooper, as resident engineer, up to September 1, and as assistant engineer for the month of September.

The number of persons employed in the Engineer Department on the 31st day of August, 1862, was 15.

The number employed on the 30th of September, in pursuance of act, chapter 169, Laws of 1862, was one engineer and one assistant engineer, with eleven persons temporarily.

The annexed table, No. 1, gives the names, rank, period of service, and compensation of all the employees in the department.

The total expenditures for engineering for the year have been as follows:

(*Under act, chapter* 105, *Laws of* 1857, *amended.*)

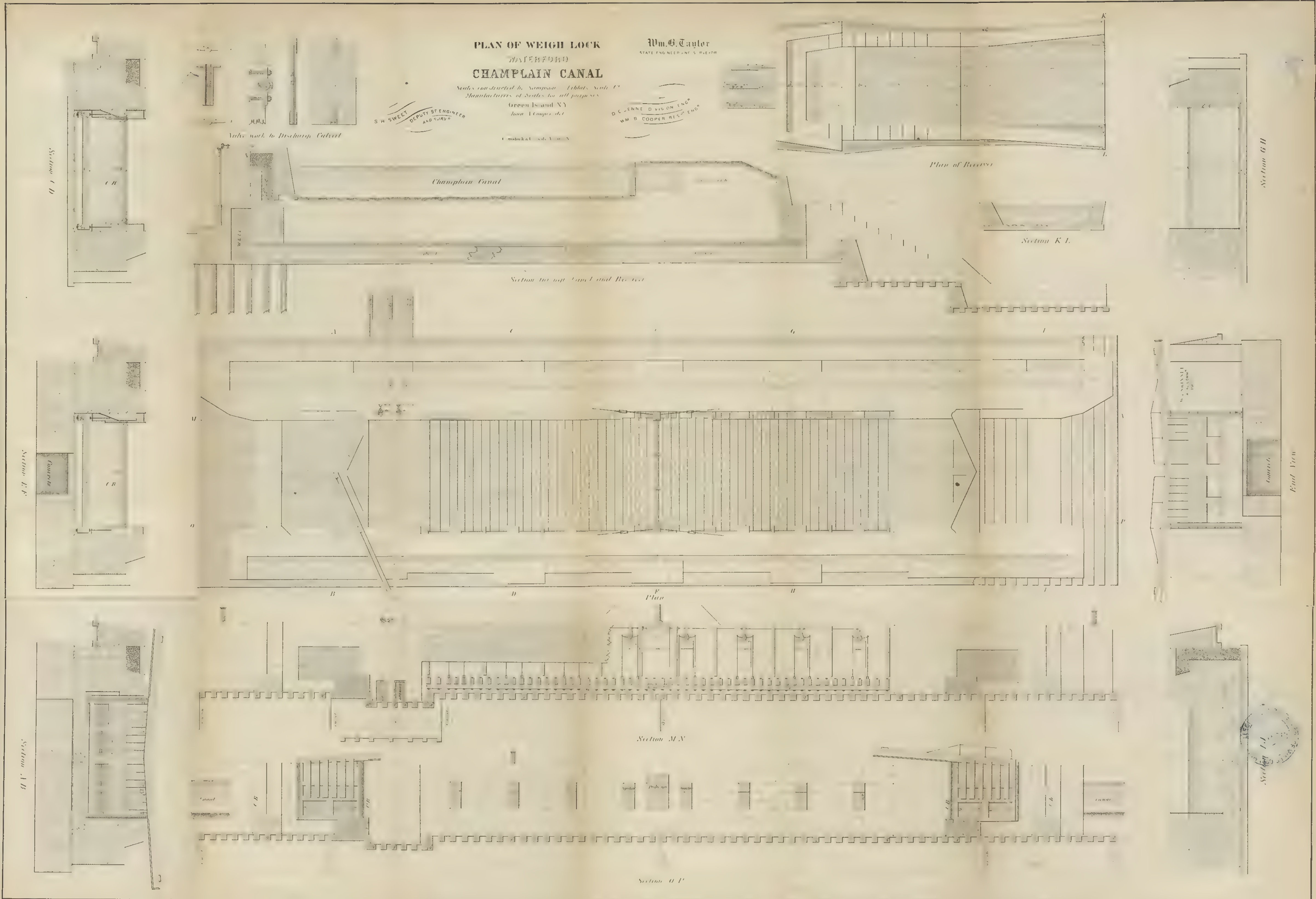
Enlargement of the Erie canal		$8,450 40
Champlain canal		6,149 84
Black River canal		3,842 69
Total construction		$18,442 93

(*Under act, chap.* 169, *Laws* 1862.)

Repairs of the Erie canal	$544 96	
do Champlain canal	167 01	
do Black River canal	66 91	
		778 88
Total engineering		$19,221 81

The amount of work done during the year on all the canals is $171,078 78.

A very considerable portion of the labor of the department


PLAN OF WEIGH LOCK
WATERFORD
CHAMPLAIN CANAL
Wm. B. Taylor
S. H. SWEET DEPUTY ST. ENGINEER AND SURV.R
Green Island N.Y.
Valve work to Discharge Culvert
Champlain Canal
Section through Canal and Reservoir
Plan of Reservoir
Section K L
Section C D
Section G H
Section E F
End View
Plan
Section M N
Section O P
Section A B
Section I J

has been expended in closing up final accounts of work completed on the enlargement of the Erie; therefore, the per centage is much greater than it would otherwise be.

Enlargement of the Erie Canal.

All the work contemplated for the enlargement in the last annual report, has been completed, and the accounts closed, excepting those for sections Nos. 60 and 62, the final accounts of which are ready for settlement.

In the month of October last the Canal Board decided to build a vertical wall 27 chains east of the waste weir near the steam mill, in the city of Utica.

This work was put under contract by the Canal Commissioners, and completed by the opening of navigation last spring, at a cost of $8,672.66. It is a very important relief to the business that is transacted at that point.

In April last, the Canal Commissioners made a contract for bottoming out the canal and raising the banks on the west end of repair section No. 3, which is also completed and settled at a cost of $6,594.28.

By act, chap. 169, Laws of 1862, the construction account of the enlargement is closed, and all the improvements hereafter made are to come under the head of repairs.

There are many improvements necessary on this division to make the canal what it should be to transact the increased amount of business.

Champlain Canal.

The South guard lock at Cohoes, and Parish lock (No. 17) on Wood creek, were completed and brought into use last spring.

The weigh lock and house, with the discharge culvert and channel for the same, at Waterford, were completed and brought into use about the 1st of July.

The scale of this lock has been constructed upon a plan entirely different from anything of the kind in this country. It is styled "Sampson's Patent Scales," and was built by Sampson, Tibbetts & Co. of Troy. Some little delay was occasioned in perfecting the fixtures for accurately adjusting the same, as the principle had never been applied to a scale in this form before. The adjustment was made with entire satisfaction, the scale performing its work in the most simple manner and with great accuracy. It

makes no difference whether the load, when being weighed, is equally distributed on the cradle or not. The suspension of the scale is entirely within the lock, nothing being shown above the lock walls but a simple cast iron cylinder, which passes over the lock chamber through which are carried the rods, transmitting the weight of one side to the other side, thence to the scale beam in the office.

Unlike other scales, this plan dispenses with a house over the lock, and consequently diminishes the cost of the work, both of the structure and the scale, at least $5,500.

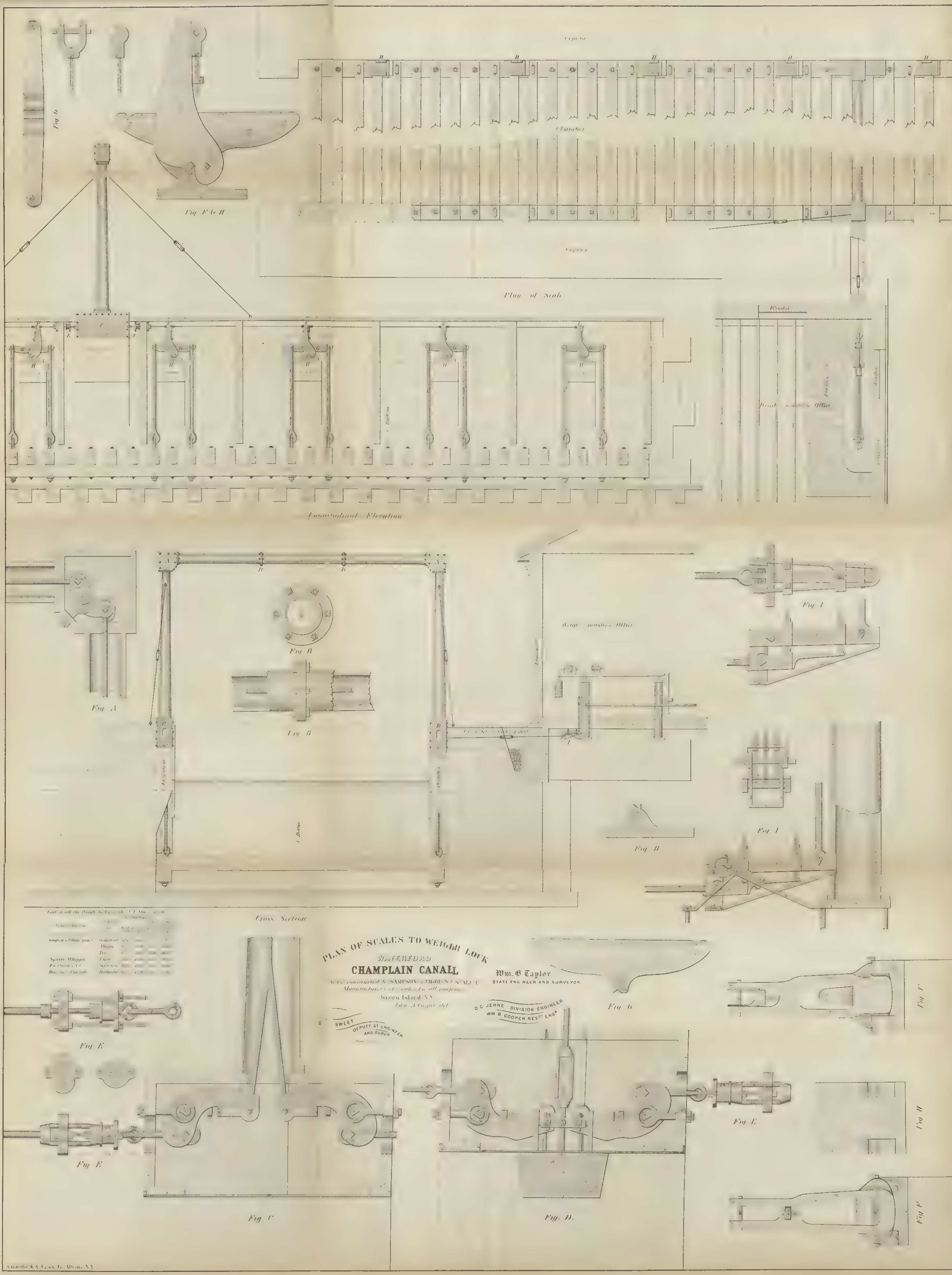
In point of economy of construction this plan far exceeds any other, and the expense of keeping in repair and adjustment must be much less.

This plan can be easily adapted to canals navigated by steam or sail vessels, as the rods which transmit the weight from one side to the other can, at a small expense, be passed under the lock through a culvert, and wells on each side with as much accuracy as when the rods pass over the lock. It can also be adapted to any class of vessels, however large, by proportioning the lock and scales to the size and tonnage desired to be weighed.

The completion of this weigh lock has been of great benefit to the navigation of the Erie canal, by relieving the West Troy weigh lock of all the boats that come from the Champlain canal, and permitting all boats that desired, to pass into the Hudson river at Waterford. From July 15th to December 7th, there has been weighed at Waterford, 3,987 boats, and at West Troy, 3,282 boats. It is very important that the berme bank of the canal, each side of this weigh lock, should be straightened, as boats cannot enter the lock without some trouble. This will be done when the contemplated improvements are made in the Waterford level.

The dam across the Mohawk river at Cohoes has been raised one and a half feet during the past summer, as contemplated, and all trouble is now obviated of boats crossing the river at low water, or of keeping up the levels on each side of the river.

Nothing has been done towards enlarging the Waterford level, as designed last year, for the want of funds. I am of the opinion that this work ought to be done as soon as possible, and the bridges raised to the height above water, required on the Erie canal, as large class boats frequently go to Waterford with freight, and are not able to return light without endangering the


PLAN OF SCALES TO WEIGH LOCK
WATERFORD
CHAMPLAIN CANALL
Green Island NY
Wm. B Taylor
STATE ENGINEER AND SURVEYOR
D C JENNE DIVISION ENGINEER
WM B COOPER RES^DT ENG^R
SWEET
DEPUTY ST ENGINEER AND SURVR
Plan of Scale
Longitudinal Elevation
Cross Section
Weigh masters Office
Fig F G H
Fig A
Fig B
Fig I
Fig H
Fig E
Fig C
Fig. D.
Fig G
Fig F
Rochester
Albany
Troy

bridges, and some have been knocked down in this way the past year.

The contract for driving piles on the sixteen and five mile levels has been nearly completed.

By a resolution of the Canal Board a stone dam was ordered built across Wood creek, at Parish lock, and the work has been nearly completed by the contractor for said lock, under his contract.

Contracts were entered into last January for stopping leaks in the Glens Falls feeder, and embraces that portion which passes over the limestone ledges at Glens Falls. Serious trouble has occurred here on account of the loss of water through the crevices of the rocks, and large sums of money have been expended to obviate the difficulty, but to no purpose.

By a resolution of the Canal Board a plan was adopted, as recommended by Wm. B. Taylor, Esq., then Division Engineer, to excavate the bottom below and fill up with concrete and rubble masonry; also to excavate and to build a vertical wall, laid in cement, on both sides.

Some thirty-two chains of this work was done last spring, and brought into use. The result has been such as to warrant complete success when the whole is finished.

This work extends one mile and a quarter.

The feeder at this point is made 35 feet wide on bottom, and 5 feet depth, as required by act, chap. 213, Laws of 1860.

I would recommend that a part of this work at Glens Falls be made 48 feet wide on the bottom, in order to accommodate the increasing business at that place, and that the same be extended 25 chains above the bridge at Glens Falls to a point known as "Log roll way."

The locks at Fort Miller, Moseskill and Fort Edward are in a very dilapidated condition, and require rebuilding the coming year. A law passed the Legislature the last session appropriating $50,000 for this work, but failed to receive the signature of the Governor.

Surveys, maps, plans and estimates have been perfected for all this work, and adopted by the Canal Board at a cost of $89,800. The first named lock is located on the old site and will have to be built during the suspension of navigation, but the materials should be all procured during the season previous, so as to admit of no delay.

The two last named locks have new locations, and can be completed during the summer season, except the connections with the main canal, at head and foot of lock.

There are twenty locks and four guard locks on the main canal; three locks on the Waterford side cut, and thirteen locks and one guard lock on the Glens Falls feeder.

Eleven of the locks and three of the guard locks on the main canal, also three locks on the Waterford side cut, have been rebuilt and enlarged. There still remains six locks between Waterford and Stillwater, the three above mentioned at Fort Miller, Moseskill and Fort Edward, and the guard lock on Wood creek, to be rebuilt, on the main canal, to form a continuous line of enlarged locks from Albany to Lake Champlain.

Black River Canal.

All the work for this canal has been completed, with the exception of two bridges across Black river, at Carter's Ferry and Tiffany's Landing, which are being built under a special law, act, chap. 213, Laws of 1860, and will be finished by the first of January.

The lock and dam at Otter creek, which was brought into use in the fall of 1861, produces good navigation in the river, from this point to Lyons Falls.

The location of this lock is such, that in high water Otter creek runs directly across the channel, from foot of lock, and fills up the same with sand and other deposit so as to interrupt navigation.

The only remedy for this is to extend above high water a pier about 300 feet below foot of lock on river side; also on the lock embankment to build a guard bank 200 feet on river side, and one on the land side of 500 feet, both above high water.

This will give such direction to the current below as will obviate the difficulty.

That part of the river from Otter creek to a point two miles below Beach's bridge is in very bad condition, and it will be impossible, in such dry seasons as the past has been, to keep good navigation by the plan of dredging a channel. Some other plan will have to be devised for this part of the river, and as the plan of jetty dams and piers has been abandoned, it will be necessary either to construct another lock and dam below Beach's bridge, or to build reservoirs on the head waters of Moose river, to keep up the supply of water. Surveys were made in 1851 of the

chain of lakes at the head of Moose river, and sufficient data obtained to show that a large quantity of water could be reserved at a moderate expense.

On page 46 of the report of the State Engineer for 1851, will be found a description of those lakes and their capacities; a map of the same is also on file in the office of the State Engineer and Surveyor, which gives a large amount of valuable information. (See map accompanying.)

Locating a lock and dam below Beach's bridge will seriously effect, by the flow of water, a large area of land above; and if this plan is formally adopted, damages to a very considerable extent will accrue.

In the adoption of this plan it is questionable whether good navigation could be kept up after a few years had elapsed.

The character of the banks and bed of this river is such that the channel is constantly changing; and my opinion is, that if the water was raised by a dam so as to make good navigation up to Otter creek, in ten years, perhaps less, the river would be so filled with deposit as to require as much dredging to keep a channel open for navigation as it does at the present time.

The same remarks will apply to the channel between Otter creek and Lyons Falls.

The reservoirs at the head of Black river have been used to their utmost capacity the past year, and have been of great service in keeping up the supply of water for the Black river and Erie canals.

I am of opinion that Chub lake reservoir, which was adopted and partly built, should be completed, as it would give an addition to the quantity of water held in reserve of 387,167,000 cubic feet, the surface area being 530 acres and depth 25 feet. With proper management by the man in charge of the same, there would be every probability of its being filled twice during the year. This would give a quantity of water equal to 16,000 cubic feet per minute for 115 days, while the present supply is only 11,000 cubic feet for the same time, making 5,000 feet additional to the quantity now sent to the Erie canal at Rome, a point where it is so much needed.

It is of the greatest importance that these reservoirs should be carefully superintended by some reliable person located at the North Branch reservoir, which is central between the other two. His exclusive business should be to look after them; and in con-

nection with other duties, make notes from day to day of all the facts which may occur, and to render monthly reports of the same to the State Engineer and Canal Commissioner, by printed forms for that purpose.

For the accommodation of this person, a good dwelling house should be built, with a rain gauge attached, so that an accurate fall of rain and snow from year to year shall be obtained. The Canal Commissioner, at my request, has had gauges put into the wells and bulkheads of each reservoir, so that the height of water in each can be accurately taken at every visit of the person in charge.

He should also report the days he commences drawing from each reservoir, and the number of valves opened; also, from time to time, the changes in opening or closing the same.

In this way the accurate amount of water in each reservoir, as well as the calculations of the supply constantly on hand, may be made known to the State officers in charge.

A valuable fund of information by this means will be obtained for scientific purposes and for future reference, without any material extra expense.

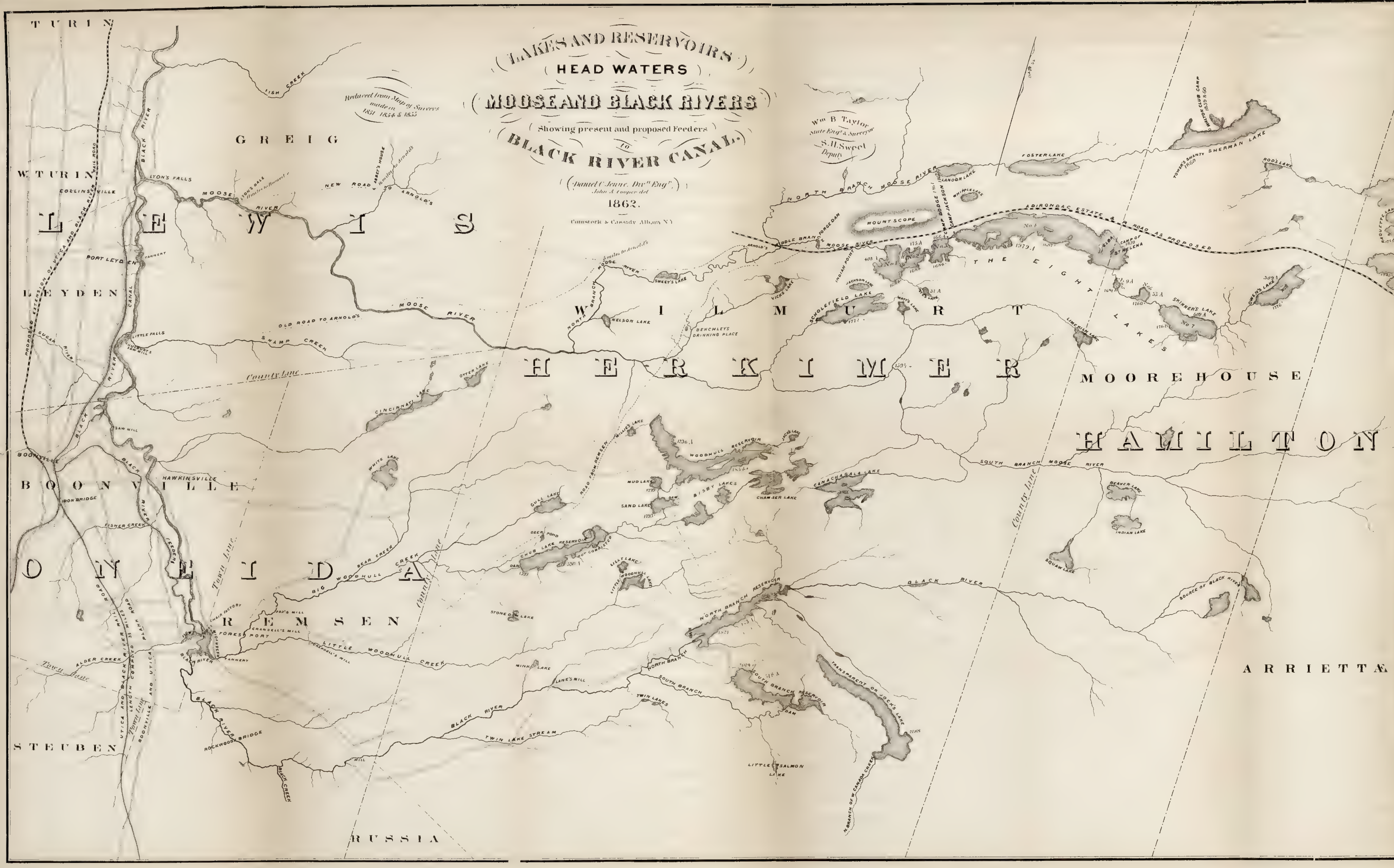
I would recommend the immediate adoption of this plan, and the erection of a house for this purpose, at a cost not to exceed five hundred dollars.

Repairs of Erie Canal.

The present system of repairs by contract, in a great measure prevents much of this work being done, as the price paid is a gross sum per year for the amount of work performed, which induces the contractor to omit everything of the kind that can be avoided.

By changing the plan of letting repair contracts, and itemizing the work under specific prices, from measurements actually made by a competent individual, this work would all be put in good order and at a reasonable expense. And here permit me to say that with all the vigilance that may be exercised by the officers in charge of the canals, it is in my opinion almost impossible to keep them in the order required, under the present system of repairs by contract for a gross sum per year for each repair section.

On the level between locks No. 1 and 2, the sides require a


LAKES AND RESERVOIRS
HEAD WATERS
MOOSE AND BLACK RIVERS
Showing present and proposed Feeders
to
BLACK RIVER CANAL.
1862.
Comstock & Cassidy Albany N.Y.
Reduced from Map of Surveys made in 1851 1854 & 1855
Wm B Taylor State Engr & Surveyor
S.H. Sweet Deputy
TURIN
GREIG
W. TURIN
COLLINSVILLE
LYON'S FALLS
L E W I S
PORT LEYDEN
LEYDEN
LITTLE FALLS
BOONVILLE
HAWKINSVILLE
IRON BRIDGE
O N E I D A
R E M S E N
FORESTPORT
ALDER CREEK
STEUBEN
RUSSIA
W I L M U R T
H E R K I M E R
MOOREHOUSE
HAMILTON
ARRIETTA
MOOSE RIVER
BLACK RIVER
NORTH BRANCH MOOSE RIVER
SOUTH BRANCH MOOSE RIVER
ADIRONDAC ESTATE & R. ROAD AS PROPOSED
THE EIGHT LAKES
MOUNT SCOPE
FOSTER LAKE
SHERMAN LAKE
SKINNER'S LAKE
OWEN'S LAKE
SCHOLEFIELD LAKE
NELSON LAKE
SWEET'S LAKE
BENCHLEY'S DRINKING PLACE
OTTER LAKE
CINCINNATI LAKE
WHITE LAKE
WOODHULL RESERVOIR
BISBY LAKES
MUD LAKE
SAND LAKE
CHAMBER LAKE
CANACHAGALA LAKE
GULL LAKE
CHUB LAKE RESERVOIR
LITTLE WOODHULL LAKE
STONE DAM LAKE
BEAVER LAKE
INDIAN LAKE
SQUAW LAKE
SOURCE OF BLACK RIVER
NORTH BRANCH RESERVOIR
SOUTH BRANCH RESERVOIR
TRANSPARENT OR JOCK'S LAKE
LITTLE SALMON LAKE
TWIN LAKES
TWIN LAKE STREAM
MINK LAKE
LANE'S MILL
BIG WOODHULL CREEK
LITTLE WOODHULL CREEK
SWAMP CREEK
BLACK CREEK
OLD ROAD TO ARNOLD'S
ROCKWOOD BRIDGE
County Line
Town Line

vertical or slope wall, and the bottom thoroughly cleaned to accommodate the increasing business.

A report has lately been made to yourself and the Canal Commissioner, constituting a committee of the Canal Board, in relation to the "big basin" and the above mentioned level, to which you are respectfully referred.

The canal at West Troy, in the vicinity of the side-cut, requires widening and a vertical wall on the towing-path side, to give more capacity to the canal, to accommodate the boats that accumulate at the weigh lock and pass out into the river at the side-cut.

The change bridge at the upper Mohawk aqueduct is very badly located at the foot of lock No. 22; the horses towing up boats having to pass by the lock in order to enter it, then return and pass over the bridge to a point above where they can fasten to the boat; this causes great inconvenience and delay.

I would recommend that this bridge be removed to a point 500 feet below lock No. 21, and below entrance of feeder. This will involve the expense of constructing a towing-path bank or bridge across the basin between the two locks, but the necessities of the case seem to demand it.

The stone dam across Schoharie creek is nearly completed and will be a very valuable improvement to the canal.

The head of the guard lock should be raised at least two feet to prevent high water running into the feeder. Protection walls are also required to connect with the wall from dam below and bank above, to make it all secure. In place of the old gates a bulkhead should be put in with a larger number of valves with increased area; in order to do this it will be necessary to put in a temporary coffer dam.

A rack should be inserted above the bulkhead to keep the flood wood from the valves. In order to shut off the water at any time, checks should be cut in the walls, to allow the insertion of timbers.

The completion of the Schoharie creek dam, which gives the canal the full benefit of this creek as a feeder, completes the chain of feeders east of Utica, and insures the required amount of water on this part of the canal. For the Rome level, an increased supply is actually necessary, and the probability is that the Fish creek feeder will have to be built. I am of opinion that

with proper care more water can be brought from Black river, if the Black River feeder was thoroughly bottomed out at the several points where the original supply of 16,000 cubic feet per minute is to be obtained.

Respectfully submitted,

DANIEL C. JENNE,

Engineer Eastern Division.

TABLE No. 1,

Showing the number and compensation of engineers employed upon the Eastern Division of the New York State canals, together with incidental expenses from October 1st, 1861, to October 1st, 1862.

ENLARGEMENT OF THE ERIE CANAL.

Name.	Rank.	Number of days.	Rate of compensation.	Amounts.
W. B. Taylor	Division engineer	------	$2,000 00	$180 00
do	(Travel)	------	---------	54 48
D. C. Jenne	Division engineer	------	2,000 00	515 87
do	(Travel)	------	---------	238 26
W. B. Cooper	Resident engineer	------	1,700 00	519 46
do	(Travel)	------	---------	534 30
A. C. Vedder	Second assistant engineer	74	2 75	203 50
A. V. Hartwell	do do	79	2 75	217 25
do	do do	208	3 00	624 00
G. M. Barnes	do do	59	2 75	162 25
R. J. Cantwell	do do	79	2 75	217 25
do	do do	103	3 00	309 00
Egbert Bagg	do do	74	2 75	203 50
Geo. Cushing, Jr.	do do	79	2 75	217 25
do	do do	156	3 00	468 00
D. Judson Jenne	Leveler	26	2 00	52 00
E. W. Murphy	do	33	2 00	66 00
John A. Cooper	Assistant engineer and draughtsman	287	3 50	1,004 50

TABLE No. 1.—Continued.

Name.	Rank.	Number of days.	Rate of Compensation.	Amounts.
David Vaughan	Draughtsman in State Engineer's office	*170	3 00	$510 00
Wm. Griffith	Rodman	287	1 50	430 50
W. H. Newkirk	do	103	1 50	154 50
H. P. Tiffany	do	4	1 50	6 00
E. C. Phillips	Tapeman	6	1 25	7 50
R. N. Vedder	do	13	1 25	16 25
W. D. Dunning	Clerk in division engineer's office	134	3 00	402 00
Jas. G. French	do resident do	134	3 00	402 00
	Incidental expenses.			
Stationery				192 71
Fuel				31 28
Light				13 95
Office rent				185 91
Postage, telegraph and express				92 62
Miscellaneous				97 31
Total for Eastern Division Erie canal				$8,332 40

* Includes 50 days services omitted in preceding year.

CHAMPLAIN CANAL.

W. B. Taylor	Division engineer		2,000 00	186 67
do	(Travel)			37 02
Daniel C. Jenne	Division engineer		2,000 00	563 52
do	(Travel)			188 94
W. B. Cooper	Resident engineer		1,700 00	519 45
do	(Travel)			226 98
E. H. Crocker	1st assistant engineer	*153	4 00	612 00
do	2d do	186	3 00	558 00
G. M. Barnes	2d do	20	2 75	55 00
do	2d do	208	3 00	624 00
George Cushing, Jr.	2d do	52	3 00	156 00
E. W. Murphy	Rodman	79	1 50	118 50
do	Leveler	175	2 00	350 00
D. Judson Jenne	do	113	2 00	226 00
H. P. Tiffany	Rodman	127	1 50	190 50
Wm. Hand	do	3	1 50	4 50
Wm. D. Dunning	Clerk in division engineer's office	77	3 00	231 00
James G. French	Clerk in resident engineer's office	77	3 00	231 00
Robert Johnson	Inspector	204	2 50	510 00
James Ray	do	65	2 50	162 50
De Witt Holman	do	24	2 50	60 00

* Includes 62 days services omitted in preceding year.

TABLE No. 1.—Continued.

Name.	Rank.	Number of days.	Rate of compensation.	Amounts.
	Incidental expenses			
Stationery				$41 33
Fuel				10 08
Light				1 42
Office rent				55 00
Postage, telegraph and express				54 93
Miscellaneous				2 00
Total for Champlain canal				$5,976 34
	BLACK RIVER CANAL.			
William B. Taylor	Division engineer		$2,000 00	$133 33
do	(Travel)			34 14
Daniel C. Jenne	Division engineer		2,000 00	167 60
do	(Travel)			59 88
William B. Cooper	Resident engineer		1,700 00	519 42
do	(Travel)		1 00	10 56
E. W. Butler	First assistant engineer	101	4 00	404 00
do	do do	186	3 50	651 00
Oscar L. Wetmore	do do	287	3 50	1,004 50
William D. Dunning	Clerk in division engineer's office	76	3 00	228 00
James G. French	Clerk in resident engineer's office	76	3 00	228 00
Samuel Alexander	Inspector	18	2 50	45 00

Incidental expenses.

Stationery			$29 40
Fuel			10 00
Light			1 40
Office rent			68 75
Postage, telegraph and express			27 80
Miscellaneous			3 20
Total for Black River canal			$3,625 98

TABLE No. 1.—Continued.

Statement showing number and compensation of engineers employed in closing final accounts, repairs, &c., for the month of September, 1862.

NAME.	Occupation.	Number of days.	Rate of compensation.	Amounts.
Daniel C. Jenne	Engineer	1 month	$2,000 00	$166 67
do	(Travel)	......	....	33 33
W. B. Cooper	Assistant engineer	1 month	1,700 00	141 67
do	(Travel)	......	....	28 56
John A. Cooper	Repairs and final accounts	26	3 50	91 00
George Cushing, Jr	Final accounts	26	3 00	78 00
A. V. Hartwell	Rebuilding Schoharie creek dam	26	3 00	78 00
W. D. Dunning	Monthly estimates and final accounts	26	3 00	78 00
E. H. Crocker	Final accounts, Champlain	26	3 00	78 00
G. M. Barnes	Construction work, do	26	3 00	78 00
E. W. Butler	Construction work, Black river	26	3 50	91 00
O. L. Wetmore	Construction work, do	26	3 50	91 00
D. Judson Jenne	Rebuilding Schoharie creek dam	26	2 00	52 00
E. W. Murphy	Final accounts, Erie	26	2 00	52 00
H. P. Tiffany	Construction work, Champlain	26	1 50	39 00
John L. Brinkerhoff	Survey of Delta feeder	6	1 50	9 00
R. N. Jenne	do do	5	1 50	7 50
Bernard Hunt	Sounding basin at Albany	3	1 50	4 50
J. G. French	Closing office at Utica	10	3 00	30 00
William Griffith	do do	10	1 50	15 00

Stationery	0 54
Lights	1 20
Office rent	23 85
Postage and telegraph	4 25
Miscellaneous	15 02
Total	$1,287 09

Distribution.

Enlargement of the Erie canal	$118 00
Champlain canal	173 50
Black River canal	216 71
Repairs of the Erie canal	544 96
do Champlain canal	167 01
do Black River canal	66 91
Total	$1,287 09

SUMMARY OF TABLE No. 1,

Showing engineering expenses for fiscal year.

Name of Canal.	Engineering proper.	Incidental expenses.	Amounts.	Totals.
Enlargement of the Erie to September 1st	$7,718 62	$613 78	$8,332 40	
do for September	118 00	----------	118 00	$8 450 00
Champlain to September 1st	5,811 58	164 76	5,976 34	
do for September	171 00	2 50	173 50	6,149 84
Black River to September 1st	3,485 43	140 55	3,625 98	
do for September	204 50	12 21	216 71	3,842 69
Repairs of Erie for September	514 31	30 65	544 96	
Repairs of Champlain for September	163 01	4 00	167 01	
Repairs of Black River for September	66 91	----------	66 91	778 88
Total	----------	----------	----------	$19,221 81

MIDDLE DIVISION.

Engineer's Office,
Syracuse, *October* 1, 1862.

Hon. Wm. B. Taylor, *State Engineer and Surveyor:*

In obedience to your instructions, I present herewith statements and estimates showing the condition of the work on the several canals embraced in the Middle Division, together with the improvements and repairs required for the same.

The canals and river navigation embraced in this division are as follows:

		Miles.
Erie canal, from the east side of the Oneida Lake canal to the east line of Wayne county		68.58
Navigable feeders:		
Limestone feeder	0.80	
Butternut do	1.55	
Camillus do	1.00	
		3.35
Oneida Lake canal		6.00
Oswego canal		38.00
Oneida River improvement		20.00
Seneca River towing path		5.00
Baldwinsville canal		1.00
Cayuga and Seneca canal		22.77
Crooked Lake canal		8.00
Chemung canal and feeder		39.00
Cayuga inlet		2.00
Chenango canal		97.00
Total Middle Division		310.70

There are also embraced in the Middle Division, for the supply of water to the canals, the following works, viz:

For the Erie canal: Ericville, Cazenovia lake, De Ruyter and the Skaneateles lake reservoirs, the Oneida, Cowassalon, Chitte-

nango, Carpenter brook, Jordan, and Weedsport feeders, all of which are completed and in use, except the De Ruyter reservoir.

For the Chenango canal: Madison brook, Woodman's pond, Leland's pond, Bradley brook, Hatch's lake, and Eaton brook reservoirs and their feeders.

The Division, up to the 15th day of July was subdivided as follows:

Residency designated as No. 1.—Embracing the Chenango, Cayuga and Seneca, Crooked lake, and Chemung canals, together with the side-cuts, feeders, reservoirs, &c., connected therewith, in charge of W. H. H. Gere, Resident Engineer.

Residency designated as No. 2.—Embracing the Erie canal, from the east bank of the Oneida Lake canal, to the east line of Wayne county, the Oswego and Oneida Lake canals, together with the side-cuts, feeders, reservoirs, &c., connected therewith, in charge of M. S. Kimball, Resident Engineer.

From the 15th to the 22d day of July, the two residencies were merged into one, and placed in charge of Ogden Edwards, Resident Engineer.

A resolution of the Canal Board, taking effect July 22d, restored the residencies as they existed previous to July 15th, placing Ogden Edwards in charge of residency No. 1, and re-installing M. S. Kimball in charge of residency No. 2, until the 1st day of September, when the act of the Legislature abolishing the office of resident engineer became operative.

Table No. 1 gives the names, rank, period of service, and compensation, of all the employees in the Department.

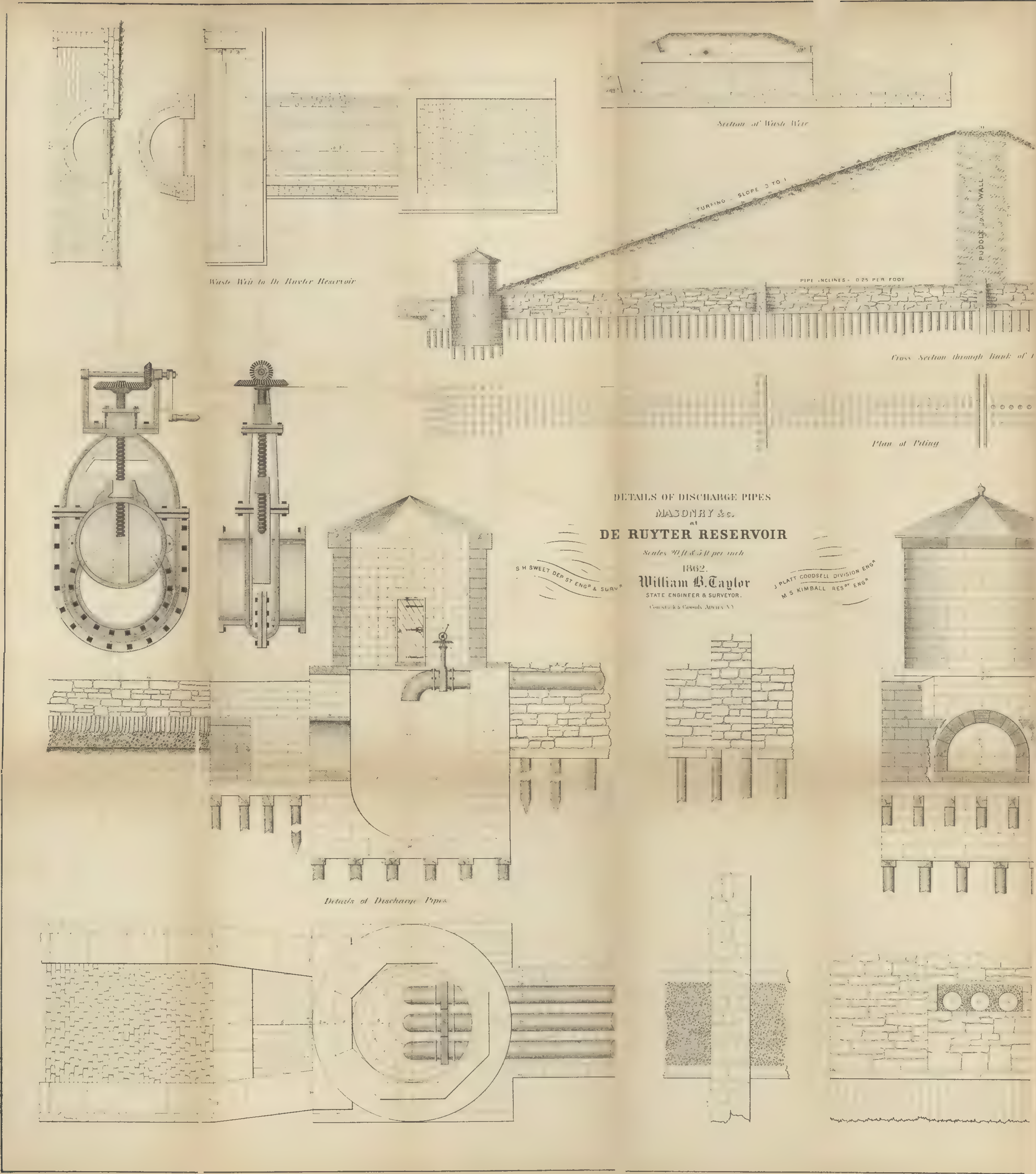
The annexed abstract No. 1 gives the amount expended by each resident engineer upon each residency, and Summary No. 1 the total expenditures on account of engineering.

The expenses of the Department for the year ending October 1, 1862, has been $24,975.77, which is $7\frac{7}{10}$ per cent. on the amount of work done.

The final accounts for all existing contracts on account of the enlargement of the Erie, Oswego, and Cayuga and Seneca canals have been closed.

Enlargement of the Erie Canal.

This division of the main canal, with all its feeders and structures, is completed, with the exception of the De Ruyter reservoir. This important work was left on the first day of Septem-



Section of Waste Weir
Waste Weir to De Ruyter Reservoir
TURFING - SLOPE 3 TO 1
PUDDLE WALL
PIPE INCLINES - 0.25 PER FOOT
Cross Section through Bank of
Plan of Piling
DETAILS OF DISCHARGE PIPES
MASONRY &c.
at
DE RUYTER RESERVOIR
Scales 20 ft & 5 ft per inch
1862.
William B. Taylor
STATE ENGINEER & SURVEYOR.
Comstock & Cassidy Albany N.Y.
S H SWEET DEP ST ENGR & SURVR
J PLATT GOODSELL DIVISION ENGR
M S KIMBALL RESDT ENGR
Details of Discharge Pipes

har

ber in an unfinished state. I would recommend that funds for its completion be provided by further legislation. It is estimated to cost $32,110 to finish the reservoir and all the structures connected therewith. In regard to the details connected with this work, and the additional structures which have been erected, or partially erected, to render the work complete in all its parts, I refer you to my report made and submitted.

The bridges have all been raised to a height nineteen feet above canal bottom, leaving a clear passage-way of twelve feet above surface water line.

The full capacity of the Lodi locks (No. 47) is frequently unattainable during the dry season of the year, for the want of a greater supply of water. This may be in a measure relieved by waters contemplated to be drawn from the De Ruyter reservoir, and, in my opinion, the relief from this source will be inadequate. I would recommend that the bottom of the prism of the canal, from the breast wall of the lock to the Chittenango feeder (a distance of fourteen miles), be excavated to a depth of fifteen inches below present bottom at the breast wall, and terminating at 0 in depth at the mouth of the feeder, making an inclined plane which will carry a much larger portion of the waters of the feeder to the lock, and give a permanent relief to existing difficulties. This declivity would of course create some current, not probably to exceed one-third of a mile per hour, which would not materially affect navigation. The channel excavated need be but twenty feet in width, until within five hundred feet of the lock, with side slopes of 3 to 1, which will prevent any interference with the stability of the slope walls. It is possible that this channel might come in contact with the extrados of the arches of the Central railroad tunnel. This fact I am unable to determine with accuracy until the close of navigation.

The weigh lock at Syracuse is unfortunately located. Its confined and cramped position, especially at its entrance from the west, together with its proximity with the mouth of the Oswego canal, renders it incapable of one-half its usefulness during any season of an unusual crowd of business, or by any failure in the Utica or Rochester weigh locks, when more than an ordinary share of work is forced upon it.

The basin, at its western end, is only capable of receiving one

boat at a time, which has to be hauled directly into it at right angles to the canal, and then moved on a line parallel with the canal into the lock. It can be greatly relieved by extending the basin westerly to such distance as shall give it a capacity for two boats, which will allow a boat coming from the west to pass directly into the lock without checking its headway, and one from the east to pass directly out into the main canal.

I would recommend that a new cradle, constructed of iron, be substituted for the one now in use. The present one is but seventy-five feet in length, and the utmost caution is necessary, in weighing boats of the largest class, to locate them in such way as to have each end project equally beyond the ends of the cradle. Boats of the largest class are ninety-eight feet in length, and there must be a projection at each end of eleven and one-half feet, which has no support. The new one should be ninety feet in length. A great saving in time can be made if an iron one is used. It takes four minutes ordinarily to empty the lock, two minutes of which are taken to discharge the water from the top of the cradle until it is clear of the water. An iron one would probably occupy but six inches; the present one is twelve inches in depth.

Supply of Water for the Jordan Level.

The Jordan level is a summit level west of Syracuse. It is fed by the Skaneateles lake at Jordan, and the Camillus, near Syracuse, a very unimportant stream in dry weather. The Jordan lock has a small lift when compared with the lock at Port Byron, farther west. Owing to this fact, there is a constant draught of water kept up between Jordan and Port Byron to furnish the supply. In any dry season the State runs the hazard of coming short of water from the Skaneateles, the only reliable source. It has been in contemplation for many years past to appropriate the Owasco creek, and take it in at Port Byron.

The property at Port Byron known as the Beach property, embracing a race two miles in length, has been burned out, and the water is now offered to the State, it is said, for less than one-eighth the price originally asked. It is therefore recommended that the State at once purchase this right and take the water into the canal, and relieve the difficulty.

The cost of taking in the water through iron pipes will not exceed $15,000.

FEEDER DAM AND BULK-HEAD
for
DE RUYTER RESERVOIR

Scale 10 ft. per in.

A. C. Scott del.

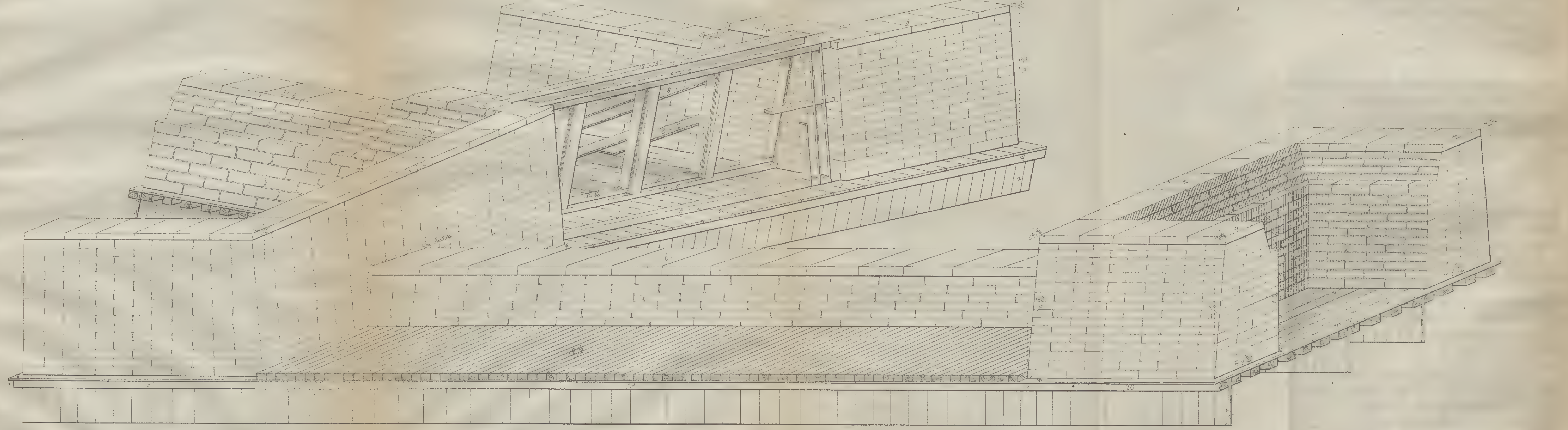
1862.

W. B. Taylor
State Engr. & Surveyor.

S. H. SWEET. DEP. ST. ENGR. & SURVR.

J. PLATT. GOODSELL. DIVISION ENGR.

M. S. KIMBALL. RESDT. ENGR.



Comstock & Cassidy Albany N.Y.

Enlargement of the Cayuga and Seneca Canal.

This canal, which connects the Cayuga and Seneca lakes with the Erie canal, at Montezuma, is now completed. The waste wall at Seneca Falls, located on the canal, between locks No. 7 and 8, and which was intended to discharge the surplus water of the canal (which is the river channel) into the mill stream channel, has been found inadequate.

The insufficiency arises from the location of the wall with reference to the current of the channel, it being precisely parallel with it. It is of vital importance to the safety of the canal, that the surplus waters which are forced into the channel during freshets, be provided with an adequate escape. There are two ways to remedy the evil: one is by building a dam or waste wall adjacent to lock No. 7, with a spillway of one hundred feet in length, which can be located at right angles to the current; or, by placing a series of waste gates near to the lock, which shall draw from canal bottom, and the water carried by a channel (protected on sides with permanent walls) parallel with the lock chamber, and discharged into the level below.

The channel at the outlet of Seneca lake, at its "north-east corner," is being dredged, under special law (act, chap. 479, Laws of 1857). The width and depth of the channel is to correspond with that of the canal. The work is not yet completed.

I apprehend that this channel, when completed, will create so much current in the channel of the main canal as to seriously retard navigation.

A new bridge is being rebuilt on Evans-street, Geneva, under special law.

Whole amount of work done the past year, $41,496.60.

Enlargement of the Oswego Canal.

All the contracts on this canal, except two, were completed on the 1st of September, as required by act, chap. 169, Laws of 1862.

One of these, the contract for dredging the river level above Fulton, known as the contract for "Sections 24, 25, 26, and part of 27," has about one thousand yards of hard, indurated material, mixed with stone of all sizes, embracing scattering boulders, to be picked up. The reason this contract was not done on the 1st of September, was on account of the high water of last

spring preventing the contractor from commencing early enough to ensure it.

The other work not completed is the contract for "Sections 22 and 23," a mile canal level below the "Horse-shoe dam." There are two causes for the non-completion of this. One, on account of the high water; and the other, the unexpected continued hardness of the bottom excavation. The contractor (sub-contractor), Thomas Gale, is still pushing on, and promises to complete it before leaving it, and trust to some future legislative action to remunerate him. This, if not fortunate to the State, will be for the boating and forwarding interest, giving the long looked for clear channel.

The cuts on some of the river levels are more or less liable to, and do become partially filled up from high water and ice dams that form and change the channels of the river for the time being. But little has been known of it, however, as, while the work has been in the hands of the construction contractors, the bars have been removed and paid for under their respective contracts—channels dug, or rather partly dug, on "Little Gascon," near Fulton, before the suspension of the first contract, were found entirely filled up, and have been re-excavated under the new.

How much trouble of this kind will be found with completed channels in future, of course, time alone can determine.

Repairs of the Oswego Canal.

Mud lock, as indicated in the last report, was taken up, the bottom piled, and the whole rebuilt and got ready, and boats passed in the afternoon of the first day of opening. This was accomplished as against a bad season, and an unprecedented high stage of water, the water being, at the highest, twenty feet above the bottom of the pit. For a time most of the stone, spread over several acres, were submerged to the depth of three feet. Coffer dams were put around the whole, and the water bailed out.

A waste weir, a short distance above the lock, has been put in the past summer, which will control the Liverpool level, and subserve the necessity of emptying through the lock as heretofore in cases of a break. It was the emptying the level through this lock that doubtless caused the failure of it last year.

LOCK No. 17 11 FEET LIFT
FOR THE
OSWEGO CANAL

S. H. SWEET, DEP. STATE ENGR. & SURVR.

Wm. B. TAYLOR, STATE ENGR. & SURVR.

J. P. GOODSELL, DIV. ENGINEER.

M. S. KIMBALL,
Resident Engineer.

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Attention is earnestly called to the condition of the old wooden dams on the river, of which something was said last year. They have been built now thirty-five years, and have, doubtless, fulfilled all that could have been expected of wooden dams, without having, at any time, been thoroughly overhauled and rebuilt. They are constantly settling, and require still higher and higher flush boards through the low water to maintain navigation. The ridge poles are literally bored to pieces, where not decayed. The interior is no longer capable of holding securely new work when added. Nothing but sleepless vigilance saved some of them during the high water of last spring. A concurrent resolution of last winter requires the Canal Board to lower the Phœnix dam to such a point as to maintain seven feet of water in the canal, and no more. It is respectfully suggested, whether it may not be now regarded as the true policy of the State, and while the matter is in hand, to rebuild it of stone, as an eventual saving of cost.

The same argument used last year to show the necessity and convenience of a weigh lock at Oswego, would be applicable now, only it would apply with much greater force. With the constantly increasing business of the canals, the delay at the Syracuse weigh lock becomes more and more serious. Send all boats ahead, and the difference of tolls at once answers the question of money to rebuild with.

Repairs of the Chenango Canal.

I have made a personal and thorough examination of all the locks upon this canal, and find that those from the summit north, which were built of the lime and sandstone of that vicinity, have retained their original proportions entire, with the exception of a few of the lower wings, which have been more or less crowded over into the canal by the constant pressure of the bank and the effect of frost, and many of them should be taken down to the top water line of the lower level and relaid.

They were originally carried up vertically, but should, when rebuilt, be laid with a batter.

Those from the summit south, which were constructed of the thin and shaly stone belonging to the formation of that section, have more or less failed.

It will be necessary to partially or entirely reconstruct the

most of them within a few years. I would recommend an appropriation of $25,000 per year for this purpose, until the whole are put in good condition.

The repairs generally have been well maintained. Much difficulty was experienced during the dry portion of the season for the want of water, especially from the summit southerly. The only remedy I can find is, the reconstruction or repair of the Kingsley Brook reservoir. An estimate of the cost to repair was submitted to you in August last. The cost to repair on the old plan was $18,172.

Repairs of Chemung Canal and Feeder.

Seven locks were rebuilt upon the main canal and three upon the feeder the past season, and ten more are to be "reconstructed to such an extent as may be required" the coming winter.

I have made a personal examination of all the locks, and the following table will give you their condition:

No. of Lock.	Condition.
1	Requires rebuilding.
2	New composite.
3	To be rebuilt this winter.
4	do do do
5	Requires rebuilding.
6	Requires rebuilding—bad condition.
7	To be rebuilt this winter.
8	Will do for two or three years.
9	New composite.
10	To be rebuilt this winter.
11	Rebuilt in 1860.
12	Rebuilt last year.
13	To be rebuilt this winter.
14	Rebuilt last year.
15	In very bad condition.
16	Will answer for one or two years.
17	do do do
18	do do do
19	Rebuilt two years ago.
20	In bad condition.
21	Rebuilt three years ago.
22	To be rebuilt this winter.
23	do do do

No. of Lock.	Condition.
24	To be rebuilt this winter.
25	do do do
26	Will do for a few years.
27	Rebuilt three years ago.
28	Will do for three or four years.
29	To be rebuilt this winter.
30	In bad condition.
31	Rebuilt three years ago.
32	Will do for three or four years.
33	Will do for two or three years.
34	Rebuilt last year.
35	Rebuilt three years ago.
36	Will do for another year.
37	Rebuilt three years ago.
38	do last year.
39	do do
40	do two years ago.
41	do three do
42	do last year.
43	do two years ago.
44	do last year.
45	do two years ago.
46	do do do
47	do do do
48	do do do
49	Elmira lock into river—will do.
50	Rebuilt last year—on feeder.
51	do do do
52	do do do
53	do guard lock—on feeder.

This canal, with the exception of the new structures lately erected, is in a most dilapidated condition. I would recommend an annual appropriation of $50,000 until all the original structures are renewed or put in a working or safe condition.

By a resolution of the Canal Board, passed March 27th, 1862, boats were allowed a draught of water of four feet, instead of three and one-half feet as heretofore. This has obliged the repair contractor to do a large amount of work which otherwise would not have been required.

The banks of the feeder had to be raised for a long distance, also the bridges, and in many places the width of the banks has been increased, and the outside slope of the bank, in many places secured by brush and stone to protect it from sliding into the adjoining creek.

Repairs of the Cayuga and Seneca Canal.

Extensive repairs have been made, though not yet completed, in the long pier at Geneva, and a new light house erected upon it. The pier has been protected by piles driven on the lake side and secured to the docking.

A plan for a new towing-path bridge at Waterloo, has been made, and the structure will be ready to put up on the close of navigation.

A new towing-path bridge over the Seneca river, at the junction, has been ordered, and will be completed before the opening in the spring.

The wood work on one side of the chamber of lock No. 11 became detached from the wall and fell in, but the damage was promptly repaired. A thorough examination of this lock will be made on the close of navigation. It seems impossible that any defect exists in the bottom, as the structure is on a pile foundation.

The repairs have been generally well kept up, and the entire canal is in a first rate condition with the above exceptions.

Repairs of the Crooked Lake Canal.

Extensive repairs have been required upon this canal, in consequence of the resolution of the Canal Board applied to the Chemung canal, which also applies to this.

The banks have been raised nearly the entire length. Brush and stone have been placed at the most exposed points next adjoining the outlet. Piles have been driven at the foot of the slopes for a long distance next to the outlet near Dresden. The pier at Dresden has also been protected by piles. A new bridge near Penn Yan has been erected. The towing-path from the guard lock at Penn Yan to the lake should be raised, and its face protected by a heavy rip-rap or slope wall.

Repairs of the Oneida Lake Canal.

This canal has been nearly useless the past season, from two causes: 1st. The locks are so worn out and worthless that they are nearly impassable, and the canal itself has been closed

a portion of the season in consequence of the waste of water involved in keeping it supplied from the Erie Canal. 2d. The obstruction at the bar, at its outlet into the lake still remains, and loaded boats which pass over have to be lightened of nearly half their freight.

Cayuga Inlet.

The channel has been dredged from Owego street to the lake, giving a depth of seven feet of water. The high bridge is being removed, and a draw is to be substituted. The pier is also being repaired. This work is being done under special law (act, chap. 458, Laws of 1862).

J. P. GOODSELL, *Engineer.*

TABLE No. 1.

Showing the number and compensation of engineers and employees in the Engineer Department of the Middle Division of the New York State canals, together with incidental expenses, for the fiscal year ending Sept. 30, 1862.

ENLARGEMENT OF THE ERIE CANAL.

Names.	Rank.	No. of days employed.	Rate of compensation.	Amount.
Henry Van Vleck	Division engineer		$2,000 00	$258 00
do	(Travel)			67 76
J. P. Goodsell	Division engineer		2,000 00	230 11
do	(Travel)			70 62
M. S. Kimball	Resident engineer		1,700 00	767 98
do	(Travel)			263 88
Ogden Edwards	Resident engineer		1,700 00	37 26
do	(Travel)			6 96
W. W. Jerome	1st assistant engineer	287	4 00	1,148 00
Julius C. Laass	2d do do	263	3 25	854 75
Charles A. Beach	2d do do	287	3 25	932 75
Charles Truesdell	2d do do	287	2 75	789 25
C. W. Downes	Leveler	287	2 25	645 75
Henry F. Greene	Draughtsman	4	2 50	10 00
N. M. Gregg	Rodman	215	1 75	376 25
H. J. Frazee	do	19	1 75	33 25
C. A. Sweet	do	33	1 75	57 75
C. A. Sweet	Leveler	53	2 00	106 00

D. H. Bruce	Clerk division and resident engineers	69	3 00	207 00
J. C. Burnham	do do do	73	3 00	219 00
Moses Poppleton	Inspector	49	2 00	98 00

Incidental expenses.

Labor	312 00
Stationery	115 29
Fuel	35 47
Light	11 48
Office rent	63 00
Postage, telegraph and express	46 16
Miscellaneous	105 47
Total	$7,869 19

ENLARGEMENT OF THE OSWEGO CANAL.

Henry Van Vleck	Division engineer		$2,000 00	$418 65
do	(Travel)			101 38
M. S. Kimball	Assistant engineer		1,700 00	767 98
do	(Travel)			499 56
Bruce Kimball	2d assistant engineer	287	2 50	717 50
J. E. Forman	Rodman	287	2 00	574 00
Patrick Murphy	Tapeman	287	1 25	358 75
A. C. Scott	Surveyor and draughtsman	287	3 00	861 00
David Vaughn	Draughtsman in State Engineer's office	79	3 00	237 00
Findley Hays	Inspector	153	1 75	267 75
C. H. Lusk	Clerk	287	2 25	645 75

TABLE No. 1.—Continued.

Names.	Rank.	No. of days employed.	Rate of compensation.	Amount.
	Incidental expenses.			
Office rent				$91 66
Stationery				60 53
Postage, telegraph and express				42 33
Fuel				48 36
Light				21 24
Labor				23 00
Affidavits				9 70
Night watching				104 25
Miscellaneous				13 47
Total				$5,863 86
ENLARGEMENT OF THE CAYUGA AND SENECA CANAL.				
Henry Van Vleck	Division engineer		$2,000 00	$222 25
do	(Travel)			54 48
W. H. H. Gerë	Resident engineer		1,700 00	541 86
do	(Travel)			218 16
Ogden Edwards	Resident engineer		1,700 00	83 85
do	(Travel)			40 26
Julius C. Laass	2d assistant engineer	14	3 25	45 50

W. V. Van Rensselaer	2d assistant engineer	287	2 75	789 25
Eugene B. Murdock	2d do do	43	2 75	118 25
M. Van Brocklin	2d do do	240	2 75	660 00
Henry F. Greene	Draughtsman	17	2 50	42 50
James Burke	do	59	2 50	148 00
James Burke	do	15	3 00	45 00
John F. Herrick	Rodman	156	1 50	234 00
John F. Herrick	do	131	1 63	213 53
D. D. Hillis	do	287	1 50	430 50
A. K. Hills	Axeman	202	1 25	252 50
D. H. Bruce	Clerk division and resident engineers	28	3 00	84 00
George B. Edwards	Clerk	10	2 50	25 00
J. C. Burnham	Clerk	19	3 00	57 00
	Incidental expenses.			
Labor				41 75
Stationery				62 06
Fuel				43 10
Light				19 97
Office rent				39 59
Postage, telegraph and express				37 66
Miscellaneous				15 85
Total				$3,565 87

TABLE No. 1.—Continued.

CROOKED LAKE CANAL.

Names.	Rank.	No. of days employed.	Rate of compensation.	Amount.
W. H. H. Gere	Resident engineer		$1,700 00	$102 39
do	(Travel)			14 04
D. E. Whitford	2d assistant engineer	5	2 75	13 75
O. M. Clauharty	Rodman	5	1 50	7 50
Total				$137 68

CHENANGO CANAL.

Names.	Rank.	No. of days employed.	Rate of compensation.	Amount.
Henry Van Vleck	Division engineer		$2,000 00	$203 32
do	(Travel)			74 76
J. P. Goodsell	Division engineer		2,000 00	21 92
do	(Travel)			10 02
W. H. H. Gere	Resident engineer		1,700 00	233 28
do	(Travel)			80 40
Ogden Edwards	Resident engineer		1,700 00	69 86
do	(Travel)			32 46
O. H. Bogardus	2d assistant engineer	131	3 25	425 75
O. H. Bogardus	2d do do	103	2 75	283 25
James Burke	Draughtsman	25	2 50	62 50
James Burke	do	15	3 00	45 00

James G. Tracy	Rodman	130	1 50	195 00
D. H. Bruce	Clerk division and resident engineers	8	3 00	24 00
George B. Edwards	Clerk	18	2 50	45 00
J. C. Burnham	Clerk	14	3 00	42 00
	Incidental expenses.			
Postage, telegraph and express				8 02
Miscellaneous				4 00
Total				$1,860 54

CHEMUNG CANAL.

Henry Van Vleck	Division engineer		$2,000 00	$266 33
do	(Travel)			106 74
J. P. Goodsell	Division engineer		2,000 00	10 96
do	(Travel)			11 64
W. H. H. Gere	Resident engineer		1,700 00	467 33
do	(Travel)			197 10
Ogden Edwards	Resident engineer		1,700 00	32 59
do	(Travel)			11 46
Julius C. Laass	2d assistant engineer	13	3 25	42 25
D. E. Whitford	2d do do	287	2 75	789 25
E. B. Murdock	2d do do	244	2 75	671 00
Henry F. Greene	Draughtsman	25	2 50	62 50
James Burke	do	66	2 50	165 00
James Burke	do	10	3 00	30 00
O. M. Clauharty	Rodman	282	1 50	423 00

TABLE No. 1.—Continued.

Names.	Rank.	No. of days employed.	Rate of compensation.	Amount.
B. M. Wentz	Rodman	185	$1 50	$277 50
D. H. Bruce	Clerk division and resident engineers	20	3 00	60 00
George B. Edwards	Clerk	8	2 50	20 00
J. C. Burnham	Clerk	16	3 00	48 00
	Incidental expenses.			
Labor				22 25
Stationery				50 61
Fuel				37 71
Light				9 25
Office rent				65 00
Postage, telegraph and express				8 51
Miscellaneous				8 05
Total				$3,894 03

TABLE No. 1.—Continued.

Schedule of engineering force in the Department, employed for the month of September.

Names.	Nature of duties.	No. of days employed.	Rate of compensation.	Amount.
J. P. Goodsell	Engineer		$2,000 00	$166 66
do	(Travel)			33 34
M. S. Kimball	Assistant engineer		1,700 00	141 66
do	(Travel)			33 34
Ogden Edwards	Assistant on repairs	26	4 00	104 00
W. W. Jerome	Closing final accounts	26	4 00	104 00
Charles Truesdell	do do	26	3 50	91 00
O. H. Bogardus	do do	26	3 50	91 00
D. H. Bruce	do do	26	3 00	78 00
J. C. Laass	do do	26	3 00	78 00
C. A. Beach	do do	26	3 00	78 00
E. B. Murdock	do do	26	3 00	78 00
A. C. Scott	do do	26	3 00	78 00
D. E. Whitford	do do	26	3 00	78 00
James Burke	do do	26	3 00	78 00
Howard Soule, Jr.	do do	17	3 00	51 00
C. A. Sweet	do do	26	2 50	65 00
C. W. Downes	do do	26	2 50	65 00
Bruce Kimball	do do	26	2 50	65 00
John O'Hara	Inspector building bridge abutments	26	2 50	65 00
C. H. Lusk	Closing final accounts	26	2 25	58 60

TABLE No. 1.—Continued.

Names.	Nature of duties.	No. of days employed.	Rate of compensation.	Amount.
J. F. Herrick	Closing final accounts	26	2 00	52 00
George B. Edwards	do do	26	2 00	52 00
Total				$1,784 60

Which amount is distributed as follows:

Chenango	$181 00	
Chemung	246 00	
Cayuga and Seneca	272 00	
Oswego	301 60	
Erie	784 00	
		$1,784 60

TABLE No. 1.—Continued.

Abstract of expenditures by Resident Engineers.

ITEMS.	Enlargement of the Erie canal.		Enlargement of the Oswego canal.		Enlarge't of Cayuga and Seneca canal.		Chemung canal.		Chenango canal.		Crooked Lake canal.	Total.
	Kimball.	Edwards	Kimball.	Edwards	Gere.	Edwards	Gere.	Edwards	Gere.	Edwards	Gere.	
Engineering, proper	$6,364 61	$189 22	$4,863 29	$66 00	$2,489 85	$539 31	$2,922 73	$374 25	$1,216 18	$322 32	$137 68	$19,485 44
Labor	312 00	....	127 25	....	30 25	11 50	22 25	....	....	....	....	503 25
Stationery	82 35	32 94	60 53	....	57 02	5 04	46 13	4 48	....	....	....	288 49
Fuel	35 47	....	48 36	....	43 10	....	37 71	....	....	....	....	164 64
Light	11 48	....	21 24	....	19 44	53	9 25	....	....	....	....	61 94
Office rent	63 00	....	91 66	....	33 21	6 38	57 50	7 50	....	....	....	259 25
Postage, telegraph and express	38 44	7 72	42 33	....	33 19	4 47	5 20	3 31	5 63	2 39	....	142 68
Miscellaneous	105 47	....	23 17	....	14 80	1 05	8 05	....	4 00	....	....	156 54
Totals	$7,012 82	$229 88	$5,277 83	$66 00	$2,720 86	$568 28	$3,108 82	$389 54	$1,225 81	$324 71	$137 68	$21,062 23

TABLE No. 1.—Continued.

Summary of engineering expenses.

Names.	Rank.	Erie canal.	Oswego canal.	Cayuga and Seneca canal.	Chemung canal.	Chenango canal.	Crooked Lake canal.	Total.
Henry Van Vleck	Division engineer	$325 76	$520 03	$276 73	$373 07	$278 08	....	$1,773 67
J. P. Goodsell	do do	300 73	....	....	22 60	31 94	....	355 27
M. S. Kimball	Resident engineer	7,012 82	5,277 83	....	....	....	....	12,290 65
W. H. H. Gere	do do	....	....	2,720 86	3,108 82	1,225 81	$137 68	7,193 17
Ogden Edwards	do do	229 88	66 00	568 28	389 54	324 71	....	1,578 41
		$7,869 19	$5,863 86	$3,565 87	$3,894 03	$1,860 54	$137 68	$23,191 17
Expenditures during the month of September, 1862		784 00	301 60	272 00	246 00	181 00	....	1,784 60
		$8,653 19	$6,165 46	$3,837 87	$4,140 03	$2,041 54	$137 68	$24,975 77

WESTERN DIVISION.

ENGINEER'S OFFICE,
ROCHESTER, Sept. 30, 1862.

Hon. WM. B. TAYLOR, *State Engineer and Surveyor:*

Sir,—In compliance with your instructions, I herewith submit my annual report of the Western Division of the canals of this State, for the year commencing the 1st of October, 1861, to 30th of September, 1862.

The canals embraced in this division are as follows:

Erie canal, from the east line of Wayne county to Buffalo		148½ miles.
Genesee Valley, from Rochester to Mill-grove	113½ miles.	
Dansville branch of Genesee Valley canal	11 miles.	
		124½ miles.
Making a total length, exclusive of feeders, reservoirs, basins and slips, of		273 miles.

ENGINEER DEPARTMENT.

This division remained divided into two subdivisions up to the 1st of September, 1862, each of which was in charge of a resident engineer.

The eastern subdivision was in charge of Daniel Richmond, resident engineer, and extended from the east line of Wayne

county to Brockport	75½ miles.
And the Genesee Valley canal	124½ miles.
Making total of	200 miles.

The western sub-division has been under the charge of Ensign Bennett, resident engineer, and extends from Brockport to Buffalo, 73 miles.

On the 1st of September, 1862, this subdivision ceased, under act, chap. 169, Laws of 1862. Since, the western division has

been in charge of Orville W. Storey. The Engineer Department has been occupied on the work under contract, both of construction and of repairs, and in making surveys, and surveys of lands belonging to the canals, for record in the Canal Department, and for the Appraisers; also in measuring up work not under contract, done and to be done; to secure and protect the navigation of the canal, and in personal attention to navigation.

After the opening of navigation last spring, tne number employed was lessened, and during September their services were confined principally to closing up final accounts, and on surveys and maps.

The late resident engineers have, since the first of September, examined and verified to final accounts, on their respective subdivisions.

The rank and number of persons employed in the Engineer Department, on the 31st of August, were as follows:

Division engineer	1
Resident engineers	2
First assistant engineers	2
Second assistant engineers	5
Surveyors and draughtsmen	4
Rodmen	3
Chainman	1
Axeman	1
Inspector	1
Total number	20

The number employed on the 30th of September was as follows:

Engineer	1
Assistants, including rodmen, chainmen and axemen	12
Total number	13

The expenses for the Engineer Department for the year have been as follows:

Erie canal	$19,110 02
Genesee Valley canal	4,164 03
Total	$23,274 05

The following statement shows the amount of work done, &c.:

Construction Erie canal	$174,224 49	
do Genesee Valley canal	5,890 88	
		$180,115 37
Repairs Erie canal	$59,811 49	
do Genesee Valley canal	53,328 76	
		113,140 24
Total		$293,255 61

The cost of engineering, including surveys upon the amount of work done as above stated, amounts on the Erie canal to $8\frac{1}{10}$ per cent. and on the Genesee Valley canal to 7 per cent.

Enlargement of the Erie.

Estimated cost to complete work under contract, September 30th, 1861	$108,330 00
Amount due on the same for Sept. 30th, 1861, to Sept. 1st, 1862, including allowance, $29,675.93, under Laws of 1862	131,647 14
Increase	$23,317 14

Amount of work done previous to Sept. 30th, 1861	$6,618,496 39
Raising bridges	694 73
Amount done since Sept. 30th, 1861, on work then under contract	131,647 14
Amount done in raising bridges not then under contract	3,188 16
Amount done on work which has not been included as enlargement work in former reports, and which was put under contract in December and March	39,389 19
Amount of per centage retained Sept. 30th, 1861	49,471 00

The work on the enlargement of the Erie canal, and on the Genesee Valley canal, is not completed, as contemplated. Many of the accounts are closed up under chap. 169, Laws of 1862, and the remaining accounts are in a forward condition to be closed.

The cost of the work on sections Nos. 252, 257, 259, 260, 261, and 262, east of Rochester, was $4,844.37 over the amount that was estimated to cost at the last annual report.

Much of it was for strengthening the embankments which experience has proved were built too light.

The high embankment at Holley has been well protected with stone, which has made a large increase on that work.

The increase on sections Nos. 316, 320, 321, and 324, has arisen from the employment of State forces, the cost of which would, as a matter of course, exceed the low prices of the contract.

The increase on the several sections of the Mountain Ridge, and Tonawanda creek, which has lately been performed by dredging, is a small per centage on the large amount of work.

On the Erie basin and slips, the work exceeds the last annual estimate, which had been kept down to as low a figure as it was deemed safe. But the expense is still less than the work would cost on the plan originally contemplated; sections Nos. 361, 362, 363, 364, 365, and 366 were increased under acts of the Legislature.

Much exertion was used during the winter to employ a sufficient force of laborers to perform all the construction work, (which could not be done during navigation,) both on the part of the contractors and by men put on the work by the Canal Commissioner. But there was not sufficient surplus labor to be found. Much work was from this cause left undone.

Some work has been done since the opening of navigation on work, besides the Erie basin, but no monthly payments were made on work done after that time.

Under the contract for excavating the bottom of the canal, made in December, 1861, and in March last, an expense to the amount of $34,250.83 has been paid.

On several of these contracts the Commissioner put on a force of men.

Much of the time during the year, the single locks proved insufficient to pass the boats and rafts; frequently many were waiting at the locks, and at the occasional detentions so many arrived that several days would elapse before the crowd ended.

The work of pressing importance to be done on the Western Division of Erie canal is making the culverts safe between Lockport and Brockport, excavating the bottom of canal where it was left undene under act, chap. 169, Laws of 1862, excavating bottom in Clyde level, widening out and protecting with stone, the narrow weak banks, and raising the lowbanks, andthe construction of 13 locks between Rochester and Cayuga marshes, and a guard lock at Black Rock.

Work on the culverts should commence immediately on the close of navigation, and all finished before the opening of navigation next spring; excavating bottom ought also to commence on the close of navigation and the contractors to put their repair contracts in proper repair. Materials for the dam should be procured this winter, and the dam finished by the first of August next.

Perfecting and securing the banks can be done after the opening of navigation next spring. The materials for locks should be procured next summer and as much other work on the locks as can be done without interrupting or incommoding navigation, and to complete the locks by the opening of navigation in the spring of 1864.

The general belief that nothing more is to be done to increase the capacity of the canal on the Western Division is fallacious; business demands it and it must be done.

Repairs.

There is much work yet required to be done on the Western Division to put the Erie canal in proper repair.

There was so much delay made in the progress of the enlargement during several years, that, in order to get the best possible channel for boats then being used, the banks were left too light, bridge embankments were not built out to proper dimensions,

slope walls were left out, and the culverts were not made safe. Since the greater draft of boats have been used, requiring more depth of water, their defects have become more apparent. Many banks require strengthening, and bottom of canal is yet to be excavated in many places.

The system of keeping the canal in repair by contract in many respects works well, and it is advantageous and economical to the State; still the system is not fully matured to derive from it the greatest advantage.

The contractors are not generally disposed to renew the structures, and it requires the utmost vigilance of energetic agents of the State to get all the work done to keep the canal in fair repair. Again, questions frequently arise whether certain work belongs properly to the repairs under the contract, or whether it is not extra—different from the manner it was constructed.

A far better system, in the opinion of the undersigned, would be to measure the work, when quantities are required, and pay for the same at specified prices; and for lock-tending, watching banks, or general care of the water, and of superintendence, a gross amount could be paid.

Genesee Valley Canal.

Since the last annual report, the extension of the Genesee Valley canal has been completed. Nothing has been done on the other work under contract.

Navigation.

The damages caused by the great flood of September 27th and 28th, 1861, were so far repaired that navigation opened in the spring of 1862—about the same time of the opening of the Erie canal.

The summer has been a very dry one, and the navigation has suffered for want of water more than usual, and for longer periods.

For several weeks the Genesee river at Mount Morris supplied only enough for a very limited number of boats, and they were passed along by filling some two or three levels at a time, while at Dansville this course was pursued during a large part of the

summer. (This manner of keeping up navigation at Dansville has been resorted to more or less since the opening of the canal.)

The Genesee river at Oramel, for a few weeks, was not quite sufficient to keep up the canal to full navigable height; and the Cuba summit failed for passing loaded boats about the 25th of August—when the waters of Oil creek reservoir were exhausted—and there was not water enough again for loaded boats until about the 25th of October.

The reservoir failed earlier than any year before, and the fall of rains commenced much later.

Repairs.

The repairs of the damage caused by the great flood of September, 1861, were done on repair section No. 1 by the Superintendent (except the abutments and some other work on the Shaker aqueduct), and on repair sections Nos. 2 and 3, by the contractor for keeping said section in repair.

The quantity of work done on repair section No. 2 was ascertained by measurements under the charge of the engineers.

The proportion the State paid to repair the same damage on repair section No. 3 was derived from the accounts furnished by the contractors.

From the foregoing it will be seen that the great repairs, where the State is liable, were made under the three different modes, viz:

1st. By Superintendents.

2d. By contractors furnishing their accounts of labor and materials.

3d. By measurements at specified prices.

The conclusions which the undersigned has drawn from the same are embodied in another part of this report.

In the foregoing repairs the banks were better protected than before the casualty, which will, in many instances, prevent damage from similar floods and lessen the damage in other places.

The Genesee river, where the canal crosses at Mount Morris,

and which has been filling up with sediment since the dam went out in 1853, has been thoroughly dredged out this season.

The Repairs to be done.

The repairs necessary on Superintendent section, No. 1, are widening the canal on the berme side, and placing the earth on the inside of the towing path along the embankment, where the towing path has so far slid off as to be both narrow and low, and in some places to drive piles to prevent further slides, and to reconstruct several waste weirs where the present ones were undermined, and to finish the Shaker aqueduct now in progress.

On repair section No. 2, it is desirable to form a bank of earth, protected on the back with stone, in place of two trunks near Portageville, and to build three stone locks in place of three wood locks.

And on repair section No. 3, to dredge out at the upper end of the canal, where it connects with the Oswego creek and the Allegany river, and to furnish a more ample supply of water for Cuba summit.

The upper section of the canal has been in use a sufficient length of time to satisfy the most sanguine that the summit is not supplied with water for all the wants of navigation. Other reservoirs are required.

I believe there has been only one year since the canal was opened when the supply was sufficient. This was in the summer of 1860. It was nearly so, however, in 1861. Dredging will be required every year at the Allegany and Oswego creek, from the sand and slabs that will drift in and settle in the still waters of the canal.

The trunks have been built so long that the timber work is getting unsafe. The foundation in which they stand, and which had a tendency to slide during the construction of the canal, appears to have become solid from the work which has been done to protect it.

The wooden locks, some 11 in number, on repair section No. 2 were built on a poor plan, and their sides are now pressed in by quicksand.

It is advisable to rebuild the same with stone as fast as they become unsafe.

The materials for three of which should be provided in the summer of 1863, and built and brought into use in the spring of 1864.

Respectfully submitted,

(Signed,) ORVILLE W. STOREY,

Engineer, Western Division.

TABLE No. 1.

Showing the number and compensation of Engineers employed upon the New York State Canals, together with incidental expenses, from October 1st, 1861, *to September 30th,* 1862.

ENLARGEMENT OF ERIE CANAL.

Western Division.

Names.	Rank.	No. of days employed.	Rate of compensation.	Amount.
Orville W. Storey	Division engineer		$2,000 00	$1,166 66
do	(Travel)			446 18
Daniel Richmond	Resident engineer		1,700 00	1,180 54
do	(Travel)			415 38
J. Nelson Tubbs	2d assistant engineer	301	3 00	903 00
Joseph W. Sprague	2d do do	250	3 00	750 00
L. L. Nichols	2d do do	156	3 00	468 00
Byron Holley	2d do do	142	2 50	355 00
George Arnolds	2d assistant engineer and clerk division engineer	270	3 50	945 00
David Vaughan	Draughtsman	79	3 00	237 00
John Bisgood	do	239	2 00	478 00
Denison Richmond	Rodman	308	1 50	462 00
Willis Nichols	do	10½	1 50	15 75
John H. Childs	Chainman	25	1 50	37 50
Wm. Blackmer	do	41	1 50	61 50
Edward W. Bangs	Tapeman	2½	1 00	2 50

John McChesner	Axeman	6	1 25	7 50
John M. Boulton	do	15½	1 25	19 37
	Incidental expenses.			
Stationery				121 17
Office rent, fuel and light				291 90
Postage, telegraph and express				235 05
Affidavits				32 70
Miscellaneous				120 66
Total				$8,752 36

Ensign Bennett	Resident engineer			$1,700 00
do	(Travel)			790 00
Stephen F. Gooding	1st assistant engineer	313	4 00	1,252 00
Charles B. Morse	2d do do	313	3 00	939 00
Stephen D. Charles	2d do do	313	3 00	939 00
Charles M. Plumb	2d do do	8	3 00	24 00
Frederick Osborne	Draughtsman	307	2 00	614 00
J. Frederick Behn	do	157	2 00	314 00
do	Inspector	156	2 00	312 00
Theodore B. Samo	do	131	2 00	262 00
do	Leveler	13	1 75	22 75
do	do	103	2 00	206 00
A. S. Gooding	do	79	1 75	138 25
do	do	117	2 00	234 00

TABLE No. 1.—Continued.

Names.	Rank.	No. of days employed.	Rate of compensation.	Amount.
John A. Ditto	Surveyor	94	$3 00	$282 00
H. Seymour, jr	Chainman	110	1 50	165 00
do	Rodman	103	1 50	154 50
Charles H. Moore	do	114	1 50	171 00
James H. Smith	do	243	1 50	364 50
Walter Griswold	do	113	1 50	169 50
Charles L. Smith	do	65	1 50	97 50
F. N. Hamlin	do	4	1 50	6 00
Jasper Youngs	do	74	1 50	111 00
L. D. Loomis	Axeman	10	1 00	10 00
Smith Reynolds	do	13	1 00	13 00
Frank J. Sawyer	do	55	1 25	68 75
Richard Reed	do	100	1 25	125 00
Alfred W. Barrett	do	59	1 25	73 75
Charles Eighmy	do	31	1 25	46 50
	Incidental expenses.			
Labor				7 11
Stationery				134 11
Office rent, fuel and light				468 07
Postage, telegraph and express				78 63

Affidavits				24 00
Miscellaneous				40 74
Total				$10,357 66

GENESEE VALLEY CANAL.

Orville W. Storey	Division engineer		$2,000 00	$833 34
do	(Travel)			381 71
Daniel Richmond	Resident engineer		1,700 00	519 46
do	(Travel)			145 62
George Porter	1st assistant engineer	313	4 00	1,252 00
J. Nelson Tubbs	2d do do	12	3 00	36 00
Joseph W. Sprague	2d do do	21	3 00	63 00
Byron Holley	2d do do	171	2 50	427 00
George Arnolds	Assistant engineer and clerk	43	3 50	150 50
John Bisgood	Draughtsman	36	2 00	72 00
Josiah Battles	Rodman	1⅔	1 50	2 50
John McArthur	Inspector	50	3 00	150 00
	Incidental expenses.			
	Stationery			6 97
	Office rent, fuel and light			110 50
	Postage, telegraph and express			11 63
	Affidavits			1 80
Total				$4,164 03

TABLE No. 1.—Continued.

Summary of expenses of the Engineer Department, for the fiscal year ending September 30th, 1862.

Names of Canals.	Amounts.	Totals.
Erie, eastern division	$8,995 36	
do middle division	8,653 19	
do western division	19,110 02	
		$36,758 57
Champlain		6,316 85
Black River		3,909 60
Oswego		6,165 46
Cayuga and Seneca		3,837 87
Chemung		4,140 03
Chenango		2,041 54
Crooked Lake		137 68
Genesee Valley		4,164 03
Total		$67,471 63

TABLE No. 2.

STATEMENT *showing the length in miles, number of structures, character of work, estimated cost at contract prices, amount of work done during fiscal year ending September 30th,* 1862, *whole amount of work done including interest and work completed or settled, with the characteristic detail of contracts existing, during the year ending September* 30, 1862, *upon the New York State Canals.*

ENLARGEMENT OF THE ERIE CANAL.

Length in miles.	No. of struct'rs	CHARACTER OF WORK.	Estimated cost at contract prices.	Am't done for fiscal year ending Sept. 30, 1862.	Whole amount done including interest.	Completed or settled.
		EASTERN DIVISION.				
4.14	....	Sections Nos. 41, 42, 43, and 44	$28,969 98	$2,799 98	$28,969 98	Settled.
	....	Add interest in pursuance of act, chap. 734, Laws of 1857	....	....	435 61	
2.98	....	Sections Nos. 45, 46, and 47	34,055 83	725 83	34,055 83	do
	....	Add interest in pursuance of act, chap. 734, Laws of 1857	....	....	407 62	
.98	....	Section No. 60	42,303 16	5,363 16	42,303 16	do
	....	Add interest in pursuance of act, chap. 734, Laws of 1857	....	....	878 93	
1.36	....	Section No. 62	129,948 86	7,448 84	129,948 86	Completed.
	....	Add interest in pursuance of act, chap. 734, Laws of 1857	....	....	2,845 14	do
	3	Bridge abutments on sections Nos. 33 and 35	6,837 15	1,127 15	6,837 15	Settled.
3.53	....	Completion of enlargement from west end of section No. 47 to lock No. 29	10,352 24	2,472 24	10,352 24	do
3.25	....	Bottoming canal below and raising banks above lock No. 34, and raising banks between locks Nos. 39 and 40	21,014 87	2,274 87	21,014 87	do
1.60	....	Bottoming canal below lock No. 42, and raising banks on sec. No. 127	2,154 78	94 78	2,154 78	do
			$275,636 87	$22,306 85	$280,204 17	
		Work authorized by act, chapter 213, Laws of 1860:				
	25	Raising bridge superstructures on superintendent section No. 1	$3,912 78	$402 78	$3,912 78	do
	43	do do do do No. 2	5,682 97	972 97	5,682 97	do
	38	do do do do No. 3	3,373 10	293 10	3,373 10	do
	24	do do do do No. 4	2,120 12	150 12	2,120 12	do
	29	do do do do No. 5	7,527 22	1,077 22	7,527 22	do
			$22,616 19	$2,896 19	$22,616 19	

TABLE No. 2.—Continued.

Length in miles.	No. of struct'rs	CHARACTER OF WORK.	Estimated cost at contract prices.	Amount done for fiscal year ending Sept. 30, 1862.	Whole amount done including interest.	Completed or settled.
		Work let by Canal Commissioners:				
		Vertical wall on sec. No. 108, in the city of Utica	$8,672 66	$8,672 66	$8,672 66	Settled.
		Bottoming Erie canal through the city of Utica	10,680 83	890 83	10,680 83	do
		Raising banks on secs. No. 83 and 84, and bot'g canal on sec. No. 84.	2,352 35	952 35	2,352 35	do
		Raising banks and bottoming canal at west end of repair sec. No. 3	6,594 28	6,594 28	6,594 28	do
		Iron bridge superstructure over Erie canal in Van Vleet st., Cohoes	3,600 00	3,000 00	3,000 00	do
			$31,300 12	$20,110 12	$31,300 12	
		MIDDLE DIVITION				
0.67		Section (west half) No. 203	$123,591 24	$23,959 24	$123,591 24	Settled.
		Add interest in pursuance of act, chap. 734, Laws of 1857	....	....	1,261 48	
1.38		Section No. 204	85,958 62	5,450 62	85,958 62	Completed.
	1	*De Ruyter Reservoir	78,114 44	42,004 44	78,114 44	do
		†Removing obstructions from outlet of Seneca lake	30,000 00	....	30,000 00	
	11	Raising bridges on repair sections No. 7 and 8	12,756 10	7,676 10	12,756 10	Settled.
	11	do do do No. 9	8,994 21	4,374 21	8,994 21	do
	14	do do do No. 7	8,245 98	1,265 98	8,245 98	do
	19	do do do No. 9	6,690 43	2,550 43	6,690 43	do
		Extra work on repair section No. 8	27,613 96	5,235 49	26,415 49	Completed.
		do do No. 9	14,838 01	14,098 01	14,838 01	Settled.
			$396,802 99	$106,614 52	$396,866 00	
		WESTERN DIVISION.				
1.09		Section No. 210	$3,859 52	....	$3,859 52	Settled.
1.09		do No. 211	11,816 23	....	11,816 23	do
2.30		do No. 252 and 257	7,559 57	$3,179 57	7,559 57	do
4.66		do Nos. 259, 260, 261 and 262	14,734 80	4,664 80	14,734 80	do
0.18		do No. 1, east of Rochester	3,093 11	545 11	3,093 11	do
4.73		do Nos. 271 and 282, and Genesee River feeder	5,410 66	710 66	5,410 66	do
1.29		do No. 289	140,263 34	7,143 34	140,263 34	do
3.43		do Nos. 316, 320, 321, and 324	13,901 96	8,841 96	13,901 96	Completed.
0.50		Section No. 6, Mountain Ridge	107,361 35	3,193 35	107,361 35	do

0.50	....	do No. 7, Mountain Ridge	108,357 10	472 10	108,357 10	do
0.50	....	do No. 8, do	104,552 15	3,288 15	104,552 15	do
0.50	....	do No. 9, do	92,019 05	2,909 05	92,019 05	do
0.50	....	do No. 10, do	100,672 15	2,080 15	100,672 15	do
0.50	....	do No. 13, do	99,878 00	....	99,878 00	do
0.36	....	do No. 14, do	75,508 00	....	75,508 00	do
11.58	....	Dredging and excavating channel in Tonawanda creek, secs. 348				
	....	to 359, inclusive	30,435 41	6,315 41	30,435 41	Settled.
5.00	....	Sections Nos. 361, 362, 363, 365, and 366, (re-let)	28,511 95	13,091 95	28,511 95	do
	....	Allowance by Canal Board pursuant to act, chap. 164, Laws of 1862	....	....	20,000 00	do
1.00	....	Section No. 364	56,000 00	10,260 00	56,000 00	do
	....	Allowance by Canal Board pursuant to act, chap. 164, Laws of 1862	....	....	3,641 93	do
	....	Sections Nos. 361, 362, 365, and 366, (old contract)	28,780 11	....	28,780 11	do
	....	Allowance by Canal Board pursuant to act, chap. 321, Laws of '62	....	....	6,034 11	do
	1	Waste weir on section No. 232	2,256 99	....	2,256 99	do
	1	do do No. 360	160 00	....	160 00	Completed.
	1	Ship lock at Black Rock	69,157 95	....	69,157 95	Settled.
	1	Valves for guard lock and gates at Black Rock	1,527 13	....	1,527 13	do
	1	Erie basin and slips	97,448 01	33,788 00	97,448 01	Completed.
	6	Iron bridge superstructures on secs. Nos. 219 and 241, inclusive..	11,154 06	....	11,154 06	Settled.
	6	do do do Nos. 264 and 275, inclusive..	18,480 75	....	18,480 75	do
	....	Add interest in pursuance of act, chap. 734, Laws of 1857	....	....	577 71	do
	5	Iron bridge superstructure on secs. Nos. 310 to 326, inclusive....	14,738 17	....	14,738 17	do
	....	Add interest in pursuance of act, chap. 734, Laws of 1857	....	....	528 16	do
	1	Iron change bridge superstructure on section 361	1,910 12	....	1,910 12	do
	1	Abutments and iron bridge superstructure, Louisiana st., Buffalo.	6,687 50	1,487 50	6,687 50	do
			$1,256,235 14	$101,971 10	$1,287,017 05	
		Work added since last annual report:				
10.84	....	Sections Nos. 208, 209, 212, 213, 214, 215, 216, 217, 218, 219, 228,				
	....	and 229	$2,710 36	$2,710 36	$2,710 36	Settled.
15.81	....	Sections Nos. 230, 231, 232, 233, 234, 235, 236, 237, 238, 239, 240,				
	....	241, 242, 243, 244, 246, and 247	1,565 68	1,565 68	1,565 68	do
8.60	....	Sections Nos. 248, 249, 250, 251, 256, 258, and 264	2,606 29	2,606 29	2,606 29	do
9.16	....	do Nos. 265, 272, 273, 275, 276, 278, 279, 280, and 281	2,905 13	2,905 13	2,905 13	do
6.84	....	do Nos. 287, 291, 292, 293, 294, 295, and 296	3,829 36	3,829 36	3,829 36	do
5.88	....	do Nos. 297, 298, 310, 311, 312, and 313	7,947 12	7,947 12	7,947 12	Completed.
3.14	....	do Nos. 314, 315, and 317	1,762 63	1,762 63	1,762 63	Settled.
5.56	....	do Nos. 318, 319, 322, 323, and 325	7,680 42	7,680 42	7,680 42	do
11.75	....	do Nos. 326 to 337, both inclusive	3,243 84	3,243 84	3,243 84	do

* Work not fully completed, but suspended by act, chap. 169, Laws of 1862. † Work not completed; appropriation exhausted. ‡ Am't remaining to be done.

TABLE No. 2.—Continued.

Length in miles.	No. of struct'rs	CHARACTER OF WORK.	Estimated cost at contract prices.	Amount done for fiscal year ending Sept. 30, 1862.	Whole amount done including interest.	Completed or settled.
	1	Timber bridge superstructure and abutments at Hamilton street, Buffalo	$5,138 36	$5,138 36	$5,138 36	Settled.
			$39,389 19	$39,389 19	$39,389 19	
	....	Raising bridges under act, chapter 213, Laws of 1860:				
	....	Completed prior to October, 1861	$694 73	....	$694 73	
	5	At Lyons, Port Gibson, and Macedon, on Supt. sec. No. 10	944 98	$944 98	944 98	Settled.
	2	At R. R. Avenue and Church st. Palmyra, on Supt. sec. No. 10	1,082 76	1,082 76	1,082 76	do
	3	At Washington, Ford, and Allen sts. Rochester, do No. 11	766 76	766 76	766 76	do
	....	Near Pittsford, at Monroe st. near foot of lock No. 66, and at Rochester Weigh lock superintendent section No. 11	393 66	393 66	393 66	do
			$3,882 89	$3,188 16	$3,882 89	

CHAMPLAIN CANAL.

Length in miles.	No. of struct'rs	CHARACTER OF WORK.	Estimated cost at contract prices.	Amount done for fiscal year ending Sept. 30, 1862.	Whole amount done including interest.	Completed or settled.
	....	Driving piles on 16 and 5 mile levels	$18,180 00	$4,430 00	$14,050 00	*$4,130 00
	1	Rebuilding Bassett lock (No. 10) enlarged	14,823 36	163 36	14,823 36	Settled.
1.17	....	Raising banks of Champlain canal from Erie to lock No. 1	4,381 70	111 70	4,381 70	do
	....	Weigh lock and weighmaster's office at Waterford	22,115 70	19,075 70	22,115 70	do
	1	Parish lock No. 17, on Wood creek	20,000 00	18,370 00	18,370 00	*$1,630 00
	1	South guard lock at Cohoes	14,274 40	14,274 40	14,274 40	Completed.
	1	Scale for weigh lock at Waterford	3,500 00	3,500 00	3,500 00	Settled.
	1	Culvert and coffer dam for weigh lock at Waterford	3,499 69	1,649 69	3,499 69	do
0.66	....	Section No. 1, stopping leaks in Glens Falls feeder	25,474 00	12,050 00	12 050 00	*13,424 00
1.00	....	do No. 2, do do do	21,334 00	6,710 00	6,710 00	*4,624 00
			$147,582 85	$80,334 85	$113,774 85	$33,808 00

BLACK RIVER CANAL.

	4	Bridges for Delta feeder	$2,086 22	$286 22	$2,086 22	Settled.
	....	Add interest in pursuance of act, chapter 734, Laws of 1857			36 05	do
	2	Dam and lock at or near Otter Creek	44,421 91	7,531 91	44,421 91	do
	1	South Branch reservoir	11,196 27	1,226 27	11,196 27	do
	1	Bridge across Black river at Carter's landing	8,981 00	5,210 00	5,800 00	†$3,181 00
	1	do do Tiffany's do	8,554 90	4,640 00	7,530 00	†1,024 90
			$75,240 30	$18,894 40	$71,070 45	4,205 90

ENLARGEMENT OF THE OSWEGO CANAL.

1.00	....	Part of sections No. 16 and 17	$21,593 34	$135 40	$21,593 34	Settled.
1.00	....	Section No. 19	39,678 88	1,244 36	39,678 88	Completed.
1.09	....	Parts of sections No. 21 and 22	20,395 15	2,548 68	20,395 15	do
.96	....	Parts of sections No. 22 and 23	30,952 00	9,127 58	30,952 00	do
3.43	....	Sections No. 24, 25, and 26, and part of 27, (re-let)	8,514 69	3,651 16	8,514 69	Settled.
1.14	....	Parts of sections No. 31 and 32	71,233 28	2,908 40	71,233 28	Completed.
0.61	....	Parts of section No. 34, (re-let)	2,892 00	571 00	2,892 00	Settled.
0.90	....	Part of section No. 35	44,815 32	4,227 64	44,815 32	do
0.20	....	Part of section No. 37	12,760 58	193 80	12,760 58	do
	1	Lift lock No. 6	24,644 13	917 13	24,644 13	do
	3	Iron bridge superstructures	14,256 00	549 50	14,256 00	do
	3	Bridges on sections Nos. 28, 29, and 31	6,254 61	336 88	6,254 61	do
	11	Raising bridges on rapair section No. 1	3,449 99	554 13	3,449 99	do
	12	do do No. 2	2,511 02	1,294 77	2,511 02	do
			$303,950 99	$28,260 43	$303,950 99	

ENLARGEMENT OF THE CAYUGA AND SENECA CANAL.

1.00	....	Section No. 1	$5,393 21	....	$5,393 21	Settled.
1.00	....	do No. 2	7,951 95	....	7,951 95	do
1.00	....	do No. 3	9,337 11	....	9,337 11	do
0.86	....	do No. 4	6,785 87	$3,655 87	6,785 87	Completed.
1.00	....	do No. 6	5,096 32	3,143 32	5,096 32	Settled.
3.50	....	do No. 8	41,354 22	2,374 22	41,354 22	do

* Amounts remaining to be done, act, chapter 169, Laws of 1862, does not apply to the Champlain canal.
† Amounts remaining to be done, work constructed under act, chapter 213, Laws of 1860.

TABLE No. 2.—Continued.

Length in miles.	No. of struct'rs	CHARACTER OF WORK.	Estimated cost at contract prices.	Amount done for fiscal year ending Sept. 30, 1862.	Whole amount done including interest.	Completed or settled.
	....	Add interest in pursuance of act, chapter 734, Laws of 1857.....	....	....	$1,240 16	Settled.
2.28	....	Section No. 11..	$20,979 72	$2,319 72	20,979 72	Completed.
2.28	....	do No. 11, (re-let)..	2,088 08	2,088 08	2,088 08	Settled.
4.48	....	do No. 12..	42,829 53	5,809 53	42,829 53	do
	....	And interest in pursuance of act, chapter 734, Laws of 1857.....	....	....	1,197 27	do
2.68	....	Section No. 13..	57,991 14	14,751 14	57,991 14	do
0.81	....	Section No. 7...	201 01	201 01	201 01	do
	....	Guard gate on section No. 9.................................	592 26	592 26	592 26	Completed.
	....	Extension of retaining wall on section No. 10..................	6,563 45	6,563 45	6,563 45	Settled.
			$207,163 87	$41,498 58	$209,601 30	

GENESEE VALLEY CANAL.

Length in miles.	No. of struct'rs	CHARACTER OF WORK.	Estimated cost at contract prices.	Amount done for fiscal year ending Sept. 30, 1862.	Whole amount done including interest.	Completed or settled.
6.70	....	Extension of the Genesee Valley canal from Olean to Millgrove pond	$79,370 88	$5,890 88	$79,370 88	Settled.
	1	Lock No. 106, including valves................................	1,180 00	....	1,180 00	do
			$80,550 88	$5,890 88	$80,550 88	

SUMMARY OF TABLE No. 2.

NAME OF CANAL.	Estimated cost at contract prices.	Amount done in fiscal year ending Sept. 30, 1862.	Whole amount done including interest.	Amount remaining to be done.
Erie canal, Eastern Division	$329,553 18	$45,313 16	$334,120 48	
do Middle Division	396,802 99	106,614 52	396,866 00	
do Western Division	1,299,507 22	144,548 45	1,330,289 13	
Total Erie canal	$2,025,863 39	$296,476 13	$2,061,275 61	
Champlain	147,582 85	80,334 85	113,774 85	$33,808 00
Black River	75,240 30	18,894 40	71,070 45	4,205 90
Oswego	303,950 99	28,260 43	303,950 99	
Cayuga and Seneca	207,163 87	41,498 58	209,601 30	
Genesee Valley	80,550 88	5,890 88	80,550 88	
Totals	$2,840,352 28	$471,355 27	$2,840,224 08	$38,013 90

TABLE No. 3.

STATEMENT *showing amount of work done under supervision of Engineer Department on repairs under contract, and miscellaneous repairs, upon the New York State canals in the fiscal year ending September* 30, 1862.

Character of work.	Estimated cost at contract prices.	Amount done in fiscal year ending September 30, 1862.	Whole amount done.	Amount remaining to be done.
ERIE CANAL.				
Eastern Division:				
Rebuilding Schoharie creek dam	$22,000 00	$11,320 00	$17,140 00	$4,860 00
Removing big bevels from locks on Superintendent section No. 2	1,787 50	212 50	1,787 50	
Arch culvert on section No. 30	3,179 10	3,179 10	3,179 10	
Miscellaneous:				
Repairs of Sauquoit creek aqueduct		44 27		
Sewer in William street, Utica		167 14		
Whitall creek culvert		140 00		
Iron bridge superstructure over feeder at Little Falls		1,778 13		
Farm do do in Danube		582 89		
Raising abutments to feeder bridge at Little Falls		1,048 65		
Raising abutments and embankments to Iron Br., Fultonville		326 24		
Removing and rebuilding Change bridge, Lower Mohawk aqueduct		1,206 00		
Rebuilding and raising superstructure, Carter's Ferry		264 20		
Repairing berme bank, near Printup's aqueduct		181 50		
Graveling bank on section No. 58		135 00		
	$26,966 60	$20,585 62	$22,106 60	$4,860 00
Middle Division:				
Culvert near Canastota	$2,700 00	$680 00	$680 00	$2,020 00
Bridge at Manlius	890 15	890 15	890 15	
	$3,590 15	$1,570 15	$1,570 15	$2,020 00
Western Division:				
Stop gate on section No. 266	$2,443 56	$488 56	$2,443 56	
do do No. 334	3,405 13	1,909 13	3,405 13	

Repairing culverts on repair section No. 12	$15,558 76	$15,558 76	$15,558 76	....
Repairing break in old canal at Holley	28,463 00	11,420 00	11,420 00	17,043 00
Miscellaneous:				
On repair section No. 10	....	11,156 52	....	....
do do 11	....	8,809 62	....	....
do do 12	....	3,774 23	....	....
do do 13	....	489 44	....	....
do do 14	....	6,205 22	....	....
	$49,870 45	$59,811 48	$32,827 45	$17,043 00
CHAMPLAIN CANAL.				
Miscellaneous:				
New pier at Empey's waste weir	....	$24 32	....	....
Improvement of channel at Eastman's waste weir	....	894 67	....	....
Rebuilding waste weir at Smith's basin	....	204 88	....	....
Improvement of dam over Mohawk at Cohoes	....	2,249 76	....	....
	....	$3,373 63	....	....
BLACK RIVER CANAL				
Miscellaneous:				
Box drain at Delta feeder	....	$254 12	....	....
Improvement of Welles' brook aqueduct	....	683 00	....	....
Iron bridge superstructure at Rome	....	1,640 00	....	....
	....	$2,577 12	....	....
OSWEGO CANAL.				
Waste weir between locks 9 and 10	$335 58	$335 58	$335 58	....
Raising tow-path below lock No. 11	476 42	476 42	476 42	....
Removing cemented sand and gravel and rock above New bridge	750 00	750 00	750 00	....
Repairing broken wall at Oswego	6,600 00	2,400 00	2,400 00	$4,200 00
New crib at High dam	233 28	233 28	233 28	....
New crib at Horse Shoe dam	1,200 00	200 00	200 00	1,000 00
Repairing dam at Baldwinsville	2,000 00	2,000 00	2,000 00	....
Apron to Bloody brook culvert	950 00	600 00	600 00	350 00
Rebuilding Mud lock	41,000 00	41,000 00	41,000 00	....
Dredging channel around Mud lock	707 00	707 00	707 00	....
Waste weir on Liverpool level	2,800 00	2,800 00	2,800 00	....
	$57,052 28	$51,502 28	$51,502 28	$5,550 00

TABLE No. 3.—Continued.

Character of work.	Estimated cost at contract prices.	Amount done in fiscal year ending September 30, 1862.	Whole amount done.	Amount remaining to be done.
CAYUGA AND SENECA CANAL.				
Excavating outlet of Seneca lake	$5,500 00	$860 00	$860 00	$4,640 00
Bridge at Evans street, Geneva	800 00	....	....	800 00
	$6,300 00	$860 00	$860 00	$5,440 00
CHENANGO CANAL.				
Lock No. 89	$5,043 94	$5,043 94	$5,043 94	....
Sherburne aqueduct	11,183 82	6,343 82	11,183 82	....
Road bridge at Norwich	1,032 43	1,032 43	1,032 43	....
	$17,260 19	$12,420 19	$17,260 19	....
CHEMUNG CANAL.				
Locks Nos. 12, 14, 34, 38, 39, 42, 44, 50, 51, 52	$89,214 46	$88,694 46	$89,214 46	....
Bridge over Catharine creek	1,365 00	1,020 00	1,020 00	$345 00
Repairs of docking at Corning, guard pier at Gibson's, and berme docking at head of guard lock at Gibson's	3,921 82	3,921 82	3,921 82	....
	$94,501 28	$93,636 28	$94,156 28	$345 00
GENESEE VALLEY CANAL.				
Repairs of break 27th and 28th September, 1861, on repair section No. 2	$39,612 14	$32,095 93	$32,095 93	$7,516 21
Repairs on repair section No. 3	17,642 17	17,642 17	17,642 17	....
Miscellaneous:				
On repair section No. 1	....	856 52	....	....
On repair section No. 2	....	162 88	....	....
On repair section No. 3	....	2,571 26	....	....
	$57,254 31	$53,328 76	$49,738 10	$7,516 21

SUMMARY OF TABLE No. 3.

NAME OF CANAL.	Estimated cost at contract prices.	Amount done in fiscal year ending September 30, 1862.	Whole amount done.	Amount remaining to be done.
Erie canal, Eastern Division	$26,966 60	$20,585 62	$22,106 60	$4,860 00
do Middle Division	3,590 15	1,570 15	1,570 15	2,020 00
do Western Division	49,870 45	59,811 48	32,827 45	17,043 00
Total Erie canal	$80,427 20	$81,967 25	$56,504 20	$23,923 00
Champlain canal	....	3,373 63	....	....
Black River canal	....	2,577 12	....	....
Oswego canal	57,052 28	51,502 28	51,502 28	5,550 00
Cayuga and Seneca canal	6,300 00	860 00	860 00	5,440 00
Chenango canal	17,260 19	12,420 19	17,260 19	....
Chemung canal	94,501 28	93,636 28	94,156 28	345 00
Genesee Valley Canal	57,254 31	53,328 76	49,738 10	7,516 21
Total	$312,795 26	$299,665 51	$270,021 05	$42,774 21

TABLE No. 4.

STATEMENT *showing No. of section, commencement and expiration of contract, name of contractor, length in miles, amount per annum, and location of repair sections under contract on the New York State canals.*

Number of section.	Commencement.	Expiration.	Name of contractor.	Length in miles.	Price p'r annum.	Description.
Erie, section 1	March 4, 1860	March 4, 1863	Charles T. Baldwin	19	$28,440	From Albany to north end Lower Mohawk aqueduct.
do 2	March 4, 1860	March 4, 1863	Wm. McClary	32	9,700	From north end Lower Mohawk aqueduct to head of lock No. 27.
do 3	May 1, 1862	Jan. 1, 1867	Jared P. Dodge, Jr., assigned to Geo. H. Peck	33	10,900	From head of lock No. 27 to foot of lock No. 34.
do 4	May 1, 1862	Jan. 1, 1867	Hosch & Lowell	24	12,780	From foot of lock No. 34 to head of lock No. 45.
do 5	March 4, 1860	March 4, 1863	Eli T. Bangs	34	5,890	From head of lock No. 45 to Oneida Lake canal.
do 7	May 1, 1861	May 1, 1866	Thomas Gale	27	3,490	From Oneida Lake canal to Limestone Creek feeder.
do 8	Oct. 1, 1859	Oct. 1, 1862	Lewis Seelye	13	7,000	From Limestone Creek feeder to foot of lock No. 50.
do 9	May 1, 1861	May 1, 1866	Charles J. Hayden	35	7,000	From foot of lock No. 50 to east line of Wayne co.
do 10	March 4, 1860	March 4, 1863	John C. Hunt	42	9,439	From east line of Wayne co. to east line of Monroe co.
do 11	Oct. 1, 1859	Oct. 1, 1862	Myron H. Mills, assigned to Chauncey Dodge	38	8,280	From east line of Monroe county to west end of section No. 284, at Brockport.
do 12	April 1, 1862	Jan. 1, 1867	Edward A. Mills	30	6,700	From west end of sec. 284 to west line of Orleans co.
do 13	Mar. 15, 1861	Mar. 15, 1866	Francis Hitchins	26	9,800	From west line of Orleans county to Pickard s bridge, over Tonawanda creek.
do 14	March 1, 1860	March 1, 1863	Wm. H. Douglas	17	14,500	From Pickard s bridge to Buffalo.
Champlain, section 1	Not under cont.	....	....	28	....	From guard lock at Cohoes to foot of lock next north of Fort Miller bridge.
do 2	Aug. 1, 1860	Aug. 1, 1865	Anson Bangs	24	9,300	From foot of lock north of Fort Miller bridge to Dunham's basin.
do 3	Aug. 1, 1860	Aug. 1, 1865	Solon Vandenburgh, assigned to Wm. Burling	22	4,300	From Dunham's basin to Whitehall.
Black River canal, section 1	May 1, 1861	Jan. 1, 1866	Edw. H. Edwards	24	8,700	From Rome to 1,000 feet north of lock No. 70.
do do 2	March 1, 1861	March 1, 1866	Benj. F. Maxson	23	4,178	From 1,000 feet north of lock No. 70 to foot of dock below lock No. 109.
Black River improvement	Nov. 1, 1859	Nov. 1, 1864	Ward & McVickar	42¼	3,800	From Lyon's Falls to Carthage.

Chenango, section 1	May 1, 1861	May 1, 1866	A. Peck & Co.	31	13,990	From Utica to foot of lock No. 81.
do 2	Oct. 1, 1860	Oct. 1, 1865	John P. Smith	34	5,600	From foot of lock No. 81 to bridge next north of feeder below Oxford.
do 3	May 1, 1861	May 1, 1866	Josiah Brintnall, assigned to Snook & Beebe	32	7,000	From bridge north of feeder below Oxford to Binghamton.
Oneida Lake canal and feeder	Oct. 1, 1860	Oct. 1, 1865	Wm. R. Chapman	6	2,375	
Oswego, section 1	May 1, 1862	Jan. 1, 1867	Wm. Avery	$21\frac{1}{2}$	9,000	From Syracuse to Three river point.
do 2	May 1, 1862	Jan. 1, 1867	Chas. E. Case	43	11,900	From Three river point to Oswego.
Cayuga and Seneca	July 1, 1862	Jan. 1, 1867	Geo. M. Case	23	9,950	
Crooked Lake canal	Oct. 1, 1860	Oct. 1, 1865	H. W. Randall, assigned to Farley Holmes	8	3,869	
Chemung canal and feeder	April 1, 1862	Jan. 1, 1867	James Bellows, assigned to Jarvis Lord	39	15,960	
Genesee Valley, section 1	Feb. 1, 1862	Feb. 1, 1867	Wm. McArthur	52	8,472	From Rochester to Dansville side cut.
do do 2	Mar. 15, 1861	Mar. 15, 1866	John Lambert, assigned to Geo. D. Lord	36	12,540	From Dansville side cut to Oramel.
do do 3	Aug. 1, 1860	Aug. 1, 1865	Wm. McArthur, assigned to Luckey & Martin	38	7,433	From Oramel to Millgrove pond, Allegany river.

DOCUMENTARY SKETCH

OF THE

NEW YORK STATE CANALS,

BY

S. H. SWEET, *Deputy State Engineer and Surveyor.*

The Law passed April 10, 1862, declaring the enlargement and construction account of our New York State canals, closed on the 1st of September, 1862, makes this a proper occasion to present a few important facts concerning the rise and progress of our public works.

It is due to the memory of those statesmen of great and comprehensive intellects, who, unequaled in the past, and models for the future, planned and guided us through this gigantic canal policy, that a complete history, both legislative and financial, should be written under legislative authority.

In no period of our public records can such cogent reasoning, and earnest eloquence, be found, as in the earlier reports of canal officials and legislative committees, until our canal policy was fairly established. The undertaking was a stupendous one, and hence the necessity of profound and earnest arguments to mould public sentiment, and inspire confidence in the vast enterprise.

The public works of the old world were projected and encouraged under the patronage of powerful monarchies, and the extraordinary character of many of their designs has commanded the admiration of the civilized world; but it remained for a free State of the new world to create a new era in the history of internal improvements, and to complete an enterprise which has contributed more to the advancement of commerce and civilization than any similar work recorded in history.

The idea of controlling the trade of the west by linking the great lakes to the Hudson river, seems to have been entertained

at an early day. The manner in which it should be perfected, however, was arrived at after many years of experiments in the improvement of natural channels. As the true theory of this idea progressed, it was found that not only could the lakes and rivers of the west and east be bound together by water communication, but that the smaller lakes and streams within the borders of our own State, by means of lateral canals, could be made tributaries to this avenue of commerce, affording outlets to the wealth and resources of the State as complete as could be desired.

At the commencement of our canals, engineering was a rare acquirement in this country, and we had no experienced contractors. The Canal Commissioners, on whom success or disaster depended, felt their way with caution. A powerful and vigilant opposition watched, with eagle eye, their movements. A disaster, however slight, might, in the hesitating condition of the public mind, have delayed the work for years, and perhaps forever.

Washington was the originator and promoter of canals in this country. In 1785, his great mind was intently fixed on the project of connecting the western waters, by artificial channels, with the Potomac, and improving the navigation of the Monongahelia, and other branches of the Ohio, principally with a view of diverting the fur trade from Detroit to Alexandria, instead of going to Montreal, as heretofore. In 1787, a canal, twenty-two miles long, was projected, from the head branch of Cooper's river (which empties into Charleston harbor) to the Santee, spreading in several branches over the greater part of the interior of the two Carolinas. Previous to the revolutionary war, Washington projected a canal from the Paspotawk river, through the Dismal Swamp, to a branch of the Elizabeth river passing by Norfolk, so as to connect the waters of the Chesapeake with those of the Albemarle Sound. Thus, the project of canals, to connect the waters in the Southern States, was familiar previous to 1788.

As early as December 16, 1768, the *improvement* of the Mohawk river in this State was recommended to the General Assembly by Sir Henry Moore, Governor of the then colony of New York. He proposed to improve the navigation at the Falls of Canajoharie by sluices, upon the plan then used on the Lan-

guedoc canal, in France. These improvements were for the benefit of the fur trade.

Christopher Calles petitioned the General Assemby, proposing a plan for improving the inland navigation on the Mohawk, Nov. 6, 1847.

In September, 1788, Elkanah Watson, from this State, who was conversant with Washington's canal project, conceived the practicability of counteracting Washington's favorite scheme, of diverting the western traffic to Alexandria, by connecting Wood creek w ith the Mohawk river, and improving the Mohawk with locks—thus establishing a water communication from the Hudson to Lake Ontario, via Oneida lake and river,and the Oswego river.

On the 5th of January, 1791, Governor George Clinton, in his speech to the Legislature, urged the necessity of improving the natural water channels, so as to facilitate communications with the frontier settlements.

On the 15th of February, 1791, a joint committee was appointed to enquire "what obstructions in the Hudson and Mohawk rivers would be proper to be removed." The materials collected by Mr. Watson in his travels through the State proved of great service to the committee, and secured the early passage of the first canal Law in this State, dated March 24, 1791.

This Law authorized the Commissioners of the Land Office to explore and survey the ground between the Mohawk, at Fort Stanwix, to Wood creek, for an artificial channel, and the Mohawk to the Hudson for improvements by locks, and to estimate the cost of the same. A sum not exceeding £100 was appropriated to defray the expense of the explorations. Elkanah Watson, Gen. Schuyler and Goldsborrow Banyer were appointed commissioners to conduct the survey.

The channel of commerce, previous to 1791, was up the Mohawk from Albany to Fort Stanwix, in boats of 5 tons burthen (carrying west $1\frac{1}{2}$ to 2 tons, and down trip, or east, 5 tons), then transported two miles across the flats to Wood creek, down Wood creek into Oneida lake and river, into the Seneca and Oswego rivers, thence to Lake Ontario, and up Seneca river to Lakes Cayuga and Seneca. Salt at Salina was then worth 75 cents a bushel. By this mode of conveyance it cost from $75 to $100 per ton for transportation from Seneca lake to Albany. The time occupied in going from Albany to Seneca lake was 21 days, and in returning 8 days.

On the 3d of January, 1792, the Commissioners reported the cost to improve by locks and canals the route from Albany to Seneca lake, at $200,000. This favorable report induced the Legislature to pass the law incorporating the "NORTHERN AND WESTEDN INLAND LOCK NAVIGATION COMPANY, *passed March* 30*th*, 1792."

This law established two companies of stockholders—one for opening a lock navigation from the Hudson to Lakes Ontario and Seneca, called the "Western," and the other from the Hudson to Lake Champlain, called the "Northern Inland Lock Navigation Company." The capital stock of each to consist of 1,000 shares at $25.

Each company was afterwards allowed a capital stock of $300,000, and an increase of the same from time to time. There were 13 directors to each company elected every year. The directors to appoint collectors of tolls; the tolls not to exceed $25 per ton on the Western, and $20 on the Northern routes; the burthen of boats was registered on the bow and stern.

On the 24th of February, 1795, the Assembly voted to *subscribe* to the stock of these companies. On the 31st of March following, an act was passed, directing the Treasurer of the State to subscribe 200 shares at $50 each. Further aid was given by the State, by an act passed April 1st, 1796; and by the act of April 11, loaned the company $37,500, and took a mortgage on their property at Little Falls.

The following is a summary of an official report, made to the directors of the Western company September 1st, 1792, by a committee composed of Phillip Schulyer, Goldsborrow Banyer, and Elkanah Watson, appointed August 14, 1792.

"We proceeded on the 20th of August, by water, from Schenectady to Fort Stanwix, accompanied by surveyors and artificers, 121¾ miles, as the river runs. The depth of the Mohawk was measured in its whole extent from Schenectady, noting all the obstructions on the route; estimating the probable cost of a canal and locks at Little Falls, ¾ mile long and 39 feet fall, at £10,500; the canal at Fort Stanwix and improvement of Wood creek at £3,000, making the aggregate £39,500. We look upon Fort Stanwix, from its location at the junction of the Mohawk with Wood creek, as the future great city west of Albany."

In the spring of 1796, the western canals from Schenectady to

Seneca Falls were opened for the passage of boats of 16 tons burthen; reducing the price of transportation to $32 per ton, and $16 on returned cargoes.

This great reduction of transportation actually doubled the intrinsic value of lands and produce around our lakes.

The amount expended by the company up to December, 1804, was $367,743. This sum was subsequently swelled to $480,000, in 1813. The frequent and serious delays in navigation, by mistakes in constructing wooden and brick locks, proved a severe loss to the company. Washington made the same error in the construction of wooden locks on the Potomac. All the locks at Little Falls, German Flats and Rome rotted away in 6 years. At the two last places they were rebuilt of brick, which again failed. Under the superintendence of Mr. Weston, an English engineer, they were all rebuilt permanently of stone.

The capital stock of the company was $232,000, on which was paid to the stockholders a dividend of 3 per cent. in 1798, 3½ in 1813, 3 in 1814, 4½ in 1815, 8 in 1816, 3 in 1817, and 5½ per cent. in 1818.

$100,000 were expended on the Northern canals, which proved a total loss, and its rights were transferred to the State. Mr. Weston was employed, in 1796, in making examinations and plans for canal locks around Cohoes falls, estimating the expense at $250,000.

The toll paid the Western company for a barrel of flour passing 100 miles was 52 cents, and for a ton of goods $5.75. The total length on the whole route of artificial channel was 15 miles.

A law passed during the winter of 1798, for opening navigation between Lakes Ontario and Erie, around the falls of Niagara. The distance for canal was about seven miles, with a descent of 320 feet; the expense estimated at half a million for large boats, and double that sum for boats of 70 tons burthen. No action was taken and the law became a dead letter. The completion of the old canals in 1796, excited a lively jealousy in Pennsylvania, as appears from Geo. Mifflin's speech of that year, advising the Legislature to extend canal communications with a liberal perseverance, to retain a just proportion of the benefits from the lakes and western waters.

The Commissioners, in obedience to act of April 8, 1812, inquired the terms on which the "Western Inland Lock Navigation Com-

pany" would surrender their rights. The reply of the directors stated that they had expended $450,000, and asked of the State $190,000 for the shares held by them, exclusive of the 350 shares held by the State. Deeming their demand exorbitant, the Commissioners did not accept the terms. By an act passed June 19, 1812, commissioners were appointed to purchase all the rights and title of this company. In a report of the commissioners, dated February 17, 1816, they recommended purchasing the interests of the company. The act of April 15, 1817, empowered the commissioners to purchase their rights and interests whenever the interests of the State required, in the prosecution of the new canal. In pursuance of this act, the commissioners in their report dated January 24, 1820, estimated and appraised the damages at $151,820, to be apportioned among the stockholders of said company. This appraisement was confirmed by the judges of the supreme court, August 11, 1820, and on September 15, 1820, an agent was appointed by the directors to receive the payment which was made October 2, 1820, the individuals of the company receiving $91,616, and the people of this State becoming proprietors of $60,204 stock.

Thus on *the* 20*th October* 1820, *ended* the existence of the "*Western Inland Lock Navigation Company.*"

The utmost stretch of *their views* had been to *follow* and *improve* the track of *nature's channels.* They *never entertained* the conception of a *canal* by a direct route from the Hudson to Lake Erie. The conception of the "GRAND OR ERIE CANAL," belongs to Gouv. Morris, who, in conversation with Simeon De Witt, at Schenectady, in 1803, mentioned the project of *tapping* Lake Erie and leading its waters directly across the country to the Hudson; that the *object* would *justify the labor and expense, whatever that might be.*

His first suggestions were generally considered the effusions of an eccentric mind, indulging in romantic and visionary schemes.

The following is an extract from a letter written to a friend in Europe, about this time: "Hundreds of large ships will, in no distant period, bound on the billows of these inland seas. Shall I lead your astonishment up to the verge of incredulity? I will. Know then that one-tenth part of the expense borne by Britain in the last campaign, would enable ships to sail from London through the Hudson river into Lake Erie. As yet we only crawl along the outer shell of our country. The interior excels the

part we inhabit, in soil, in climate, in everything. The proudest empire of Europe is but a bauble compared to what America may be—must be."

Up to 1808 nothing was done to facilitate the progress of the canals, from its first conception by Gouv. Morris. The people were appalled at the magnitude of the enterprise, and none dared approach it in *earnest.*

Men of limited views considered the undertaking too hazardous for the State to attempt single handed; but a few, possessing enlarged and vigorous minds, fanned the latent spark into a blaze.

On the 27th October, 1807, Jesse Hawley commenced a series of articles on the subject, in the "Genesee Messenger," and continued them with great ability for 14 weeks.

Mr. Joshua Forman, from Onondaga, was the *first to propose the Erie canal project in the Legislature*, by offering a resolution in the Assembly, February 4, 1808, (which was concurred in by the Senate on the 5th,) appointing a joint committee to take into consideration the propriety of exploring and causing an accurate survey to be made of the most eligible route for a canal from the tide-waters of the Hudson to Lake Erie, to the end *that Congress might be enabled to appropriate such sums* necessary to the accomplishment of that great national object. Messrs. Gold, Gilbert, Forman, German and Hogeboom, House committee, and Messrs. Taylor, Nicholas and Ward, Senate committee.

Mr. Gold, from the joint committee, submitted a report March 21st, 1808, in its favor, and offered a resolution directing the Surveyor General to cause an accurate survey to be made of a route between Hudson River and Lake Erie, together with all the natural streams adjoining. It was adopted in the Assembly, but was postponed in the Senate until April 6th, when it passed by 11 majority, 20 voting for and 9 against it. By act of April 11, 1808, \$600 were appropriated to defray the expenses of the survey.

James Geddes was the first engineer appointed by the Surveyor General, Simeon De Witt, June 11, 1808. He was instructed to examine the route for a canal, from Oneida lake to Lake Ontario. Also, from Oneida lake to Oswego, by a route in part west of Oswego river; then between Lake Erie and Ontario.

Extracts from James Geddes' Report, Jan. 20, 1809.

Between Oneida Lake and Lake Ontario.

Summit between Oneida lake and Salmon creek, 110 feet above Oneida lake; 344 feet of lockage; lake 124 feet above Lake Ontario. This route not deemed feasible.

Via Oneida and Oswego Rivers.

Distance from Oneida lake to Seneca river, 18 miles, and fall 12½ feet; from 3 river point to Oswego, 24 miles, and fall 111½ feet. The route on west side of Oswego river recommended and pronounced feasible.

Niagara River.

Summit between Schlosser and Lewistown, 345 feet; fall from surface to surface, 317 feet; and from lake to lake, 334 feet. The whole charge of the portage company is 75 cents per barrel for salt, and $1 for other merchandise, from Lewistown to Black Rock; Erie to Lewistown, 26 miles. "Vessels below might sail almost under the boats above, and the goods drawn on ways up, 315 feet perpendicular, by means of machinery wrought by the water power which would run through the canal."

Interior Route.

This route is proposed from Oneida lake along Oneida and Seneca rivers, up the Mud creek valley, across the country to the Genesee river, thence up Black creek to the Tonnewanta swamp, down Tonnewanta creek to Niagara river, up Niagara river to Lake Erie. Distance from Cayuga lake to Oneida lake, 62 miles; fall 34 feet. $5.25 were the prices for carrying a ton of salt from Oswego to Lewistown. Robert Fulton's estimate for a ton carried on the proposed canal, 150 miles, is $1.50 per ton. Mr. Geddes did not, with this report, submit an estimate of the cost of construction.

From the favorable view taken of the report by the Legislature, a joint resolution passed, March 13, 1810, organizing a Board of Commissioners, with powers and means to prosecute the examinations.

The Commissioners appointed under this law, and the first acting as agents of the State were, Gouverneur Morris, Stephen Van Rensselaer, De Witt Clinton, Simeon De Witt, William North, Thomas Eddy, and Peter B. Porter.

Mr. James Geddes was continued as engineer under the direction of the Commissioners.

The act of April 5, 1810, appropriated $3,000 to defray the expenses of the Commissioners.

The first report of the Commissioners, dated March 2, 1811, states: "That on the present navigation of the Mohawk river, Wood creek, Oneida lake, and Oswego river (except portage within 12 miles of Oswego); that experience has long since exploded in Europe the idea of using the beds of rivers for navigation. A preliminary point to decide is, whether by the route from the Hudson to Ontario, vessels can be taken across, of size and form to navigate Lake Ontario and Hudson river; such, for instance, as sloops and schooners of 50 or 60 tons. The Commissioners believe this to be impracticable from the want of water at the summit level." The Commissioners advised the completion of communication from the falls, 12 miles from Oswego, by railroad to the lake, to avoid the great expense of 100 feet lockage in that distance. Lake Ontario was estimated 196 feet above tide water, and Rome level 184 feet. The report was altogether unfavorable to this route, preferring the inland route direct from Lake Erie. Lake Erie was estimated to be 329 ft. above Lake Ontario. They assumed, hypothetically, that if a canal were to run in such a manner, the average descent would be six inches in every mile. They made the distance from Lake Erie to Hudson river, 310 miles; total descent, 155 feet, and actual descent, 525 feet. The difficulties suggested were: crossing Genesee river at an elevation of 26 feet; mouth of Seneca lake at an elevation of 83 feet; and the mouth of Cayuga lake at 130 feet elevation. Height at Rome, above the Mohawk, 47 feet, and at Little Falls, 80 feet; at Schoharie, 150 feet above height of ground; between Albany and Schenectady, 70 feet. They estimated the cost of bringing a ton from Lake Erie to the Hudson, at $3, a little more than one-half of what was then paid on Lake Ontario, between Lewistown and Oswego. The cheapest rate of transportation within the past ten years between Kingston and Montreal, they stated to be $1 per hundred, ascending; and 50 cents descending the river. "But the Commissioners beg leave to observe, that no supposable expense can bear an undue proportion to the value of the work. Thus, were it (by giving a loose to fancy) extended to fifty millions of dollars, even that enormous sum does not exceed half the value of what, in all human probability, and at no

distant period, will annually be carried along the canal." A double set of locks was recommended. The estimated cost of the canal, from Lake Erie to the Hudson, was fixed by the Commissioners at $5,000,000. This able report was drawn by Gouv. Morris. After the reading of the foregoing report, De Witt Clinton asked leave to bring in a bill, entitled "An act to provide for the improvement of the internal navigation of the State," which upon permission was read a second time, and committed to the committee of the whole, and ordered printed, March 4, 1811.

The bill passed April 8, 1811, appointing the same Commissioners, adding Robert R. Livingston and Robert Fulton, and extending their powers to employ engineers, and appropriating $15,000 to defray the expenses of the Commissioners and engineers.

The Commissioners, under the act of April 8, 1811, made their second report to the Senate March 14, 1812, stating that they had, in obedience to the above act, made application to Congress and the Legislatures of the several States and territories for aid. Gouv. Morris and De Witt Clinton were bearers to the seat of government. Their efforts failed to receive the immediate aid which was asked. The Legislatures of Tennessee, Massachusetts and Ohio readily complied, and asked their members of Congress to vote for aid. New Jersey, Connecticut and Vermont refused, and Michigan preferred the canal from Lake Erie to Ontario. The Commissioners estimated the length of the canal at 350 miles, and the cost of transportation at $6 per ton; and on each barrel of flour 60 cents, and 80 cents to New York. The cost of carriage by land from Albany to Utica was stated at $15 per ton. Speaking of the opposition to the canal—"The Commissioners must, nevertheless, have the hardihood to brave the sneers and sarcasms of men, who, with too much pride to study, and too much wit to think, undervalue what they do not understand, and condemn what they cannot comprehend. Wise legislators will examine and reason upon facts." They estimated the revenue at $1,250,000, and the trade to tide water at 250,000 tons in 1831. They urged the immediate action of the Legislature, relying upon the credit of the State, saying that if postponed, "Will not a fertile imagination invent as good reasons for postponement then as now? The Commissioners reply with pain to arguments which imply insult. Who is there so base as

not to repel the charge of selfishness? What man so cold as not to feel the dignified desire of immortalizing his name, by contributing to a monument of national magnificence, unequaled by anything on earth?"

On the 8th March, 1814, the Commissioners, under a joint resolution of the Legislature, reported the progress made. They had appointed an English engineer, whose knowledge, they believed, superior in the construction of canals and railroads; but that he had not yet arrived. They, for the first, proposed a canal from the Hudson to Lake Champlain.

The following were cessions of land made to the State as a gift for prosecuting the Erie canal, appended to the foregoing report of the Commissioners:

Paul Busti, agent for Holland Company	100,632	acres
Le Roy Bayard and McEvers	2,500	do
John Greig, in behalf of Gov. Hornby	3,500	do

Robert Troup, agent Wm. Poulteney, will make a large grant in behalf of the heirs.

The third, fourth and fifth sections of the act of June 19, 1812, were repealed April 15, 1814.

Thus, from 1811 to 1816 nothing decisive was done, except that several leading steps were taken, such as appeals to Congress and individual States, to induce a patriotic coöperation. But these appeals proved of no avail. In 1812 a law was obtained authorizing a loan of five million dollars, which was subsequently repealed. On the 2d of February, 1816, Gov. Tompkins suggested to the Legislature the propriety of appropriating part of the revenue to construct the canal; observing, at the same time, that the Western States, which had an equal interest in the project, would, in all probability, coöperate.

Action that Induced the Erie Canal Construction Law.

At this session of the Legislature, 1816, petitions were presented to the Legislature from all parts of the State, and an able and eloquent memorial from the city of New York, from which the following is taken:

"The expense of transportation estimated on the canal at $1 a ton for 100 miles, and land conveyance $32. Hence, it follows that canals operate upon the general interests of society in the same way that machines for saving labor do in manufactures; they enable the farmer, the mechanic, and the merchant, to con-

vey their commodities to market, and receive a return thirty times cheaper than by roads. A great chain of mountains passes through the United States, and divides them into Eastern and Western America. In various places, rivers break through those mountains, and are finally discharged into the ocean. To the west, there is a collection of inland lakes, exceeding in aggregate extent, some of the most celebrated seas of the old world. To connect these great sections by inland navigation, to unite our Mediterranean seas with the ocean, is evidently an object of the first importance to the general prosperity. If a river or natural channel, navigable 170 miles, has been productive of such signal benefits, what blessings might not be expected of it were it extended 300 miles through the most fertile country in the universe, and united with the great seas of the west." The distance from Buffalo to the ocean, by the way of New York, is 470 miles; by Montreal, 800; by New Orleans, 2,350 miles, and Chicago to the ocean, by New York, 1,200 miles; to the mouth of the Mississippi, by New Orleans, 1,600 miles; and to the mouth of the St. Lawrence, by Montreal, 1,600 miles. The distance from Detroit to the ocean, by New York, is 700 miles; by Montreal, 1,050 miles; by Cleveland, down the Muskingum, 2,400 miles. The distance from Pittsburgh to the ocean, by Le Beuf, Lake Buffalo, and New York, is 700 miles. The same to the ocean, by Buffalo and Montreal, 1,050 miles." Again: "From Buffalo to Albany a ton could be conveyed on the intended canal for $3, and from Albany to New York the present charge is $2.80. Present expense by water from the city of New York to Sandusky, $4.50 per hundred." "The whole line of the canal will exhibit boats loaded with flour, pork, beef, &c., and the other valuable productions of our country; and, also, with merchandise from all parts of the world. Great manufacturing establishments will spring up; agriculture will establish its granaries, and commerce its warehouses in all directions. Villages, towns and cities will line the banks of the canal and the shores of the Hudson from Erie to New York. The wilderness and the solitary place will become glad, and the desert will rejoice and blossom as the rose."

"It is contended on the one side that the canal should commence in the vicinity of the outlet of Lake Erie, and be carried across the country to the head waters of the Mohawk river, at Rome, from whence it should be continued along the valley of

the Mohawk to the Hudson. It is on the other side, insisted that it should be cut around the cataract of Niagara; that Lake Ontario should be navigated to the mouth of the Oswego river; that the navigation of that river and Wood creek should be improved and pursued until the junction of the latter with the Mohawk at Rome. As to the expediency of a canal from Rome to the Hudson, there is no discrepance of opinion; the route from Rome to the great lakes constitutes the subject of controversy." "The most serious objection against the Ontario route is, that it would inevitably enrich the territory of a foreign power at the expense of the United States. A barrel of flour is now transported from Cayuga lake to Montreal for $1.50, and it cannot be conveyed to Albany for less than $2.50."

"The Languedoc canal, in France, connecting the Mediterranean and the Atlantic, is 180 miles long, has 114 locks and sluices, a tunnel 720 feet long, breadth of canal 144 feet, depth 6 feet; it was begun in 1666, and finished in 1681, at an expense of £540,000 sterling, or £3,000 sterling a mile."

"The Holstien canal, in Holland, begun in 1777, and finished in 1785, is 50 miles long, 100 feet wide at top, and 54 at bottom, and 10 feet deep. Ships pass through it drawing 9ft. 4in., from the German Ocean to the Baltic. From two to three thousand ships pass during a year. It cost $1,500,000, or $30,000 per mile."

"The canal from the Forth to the Clyde is 35 miles long. It rises and falls 160 feet, with 39 locks. Vessels pass drawing 8 feet, having 19 feet beam, and 73 feet length. It cost £200,000, or $23,000 per mile."

"The canals of England are 385½ miles long, and cost £2,411,900 sterling, or $28,000 per mile."

"The cost of canals in operation in this country—from Weymouth to Taunton, 26 miles long, lockage 260 feet, $1,250,000; from Brunswick to Trenton, 28 miles, lockage 100 feet, $800,000; from Christiana to Elk, 22 miles, lockage 148 feet, $750,000; from Elizabeth river to Pasquotauk, 22 miles, lockage 40 feet, $250,000. The average cost of these per mile being about $31,000."

This powerful and statesman-like document made a profound impression upon the Legislature, producing at once the law of April 17, 1816, the first incipient step leading to the prosecution of the great canal originating from Forman's resolution. The

whole plan was embraced under this law. The preamble stated that "the United States, and the several States immediately interested, would contribute their full proportion to the execution of the works." From that day the prosecution of the canals proceeded with a celerity that astonished its projectors and confounded its opposers.

This law followed a report from Mr. Van Rensselaer, from a joint committee of the Senate and Assembly, March 21st, 1816, stating that the anxiety on the part of the petitioners and memorialists (amounting to several thousand) should engage the early attention of the Legislature, and that vigorous measures should be adopted for the early completion of the canal. The committee also urged the speedy opening of a route from the Hudson to Lake Champlain. Messrs. James Geddes and Benjamin Wright, the engineers, furnished facts for Mr. Van Rensselaer's report, the former having charge from Lake Erie to Cayuga marshes, and the latter from the Cayuga marshes to the Hudson river.

The canal law, passed April 17, 1816, authorized: A Board of Canal Commissioners composed of Stephen Van Rensselaer, De Witt Clinton, Samuel Young, Joseph Ellicott, and Myron Holley; (DeWitt Clinton was chosen president, and Myron Holley treas'r;) the construction of the Erie and Champlain canals; to make application to the United States for aid; to employ engineers; to open subscription books; and repealing acts of April 8th, 1811, June 19th, 1812; and appropriating $20,000.

Under this act, the Commissioners made an elaborate report, March 18th, 1817. Their first meeting was held in the city of New York, May 17th. They agreed to appoint three engineers for the Erie and one for the Champlain canal. They divided the Erie into three sections—the Western from Lake Erie to Seneca river, Middle from Seneca river to Rome, and the Eastern from Rome to Albany. A fourth engineer was appointed on the Erie, to explore the country from Buffalo to the east line of the Holland Purchase.

The first engineers appointed under the act, 1816, were:

James Geddes, in charge of	Western section.	
Benjamin Wright,	do	Middle do
Chas. C. Broadhead,	do	Eastern do
William Peacock,	do	explorations Buff. to Hol. Pur.
Lewis Gavin,	do	Champlain canal.

The Commissioners, with two engineers, visited the Middlesex canal, to obtain practical information before proceeding with the surveys and estimates for the Erie and Champlain canals.

The dimensions of the Erie canal were fixed by the Commissioners at a meeting held at Utica, July 15th, 1817, as follows: Width of canal on bottom 28 feet, at surface 40 feet, and depth 4 feet; the locks 90 feet in length and 12 feet wide in the clear; the Champlain canal to be 20 feet wide on the bottom, 30 feet at surface and 3 feet deep; locks 75 feet long and 10 feet wide in clear. On this basis

THE FIRST ENGINEER'S ESTIMATE

of the Erie and Champlain canals was made March, 1817, as follows, viz:

Western section, by James Geddes	$1,801,862
Middle section, by Benjamin Wright	853,186
Eastern section, by Chas. C. Broadhead	2,271,690
Champlain canal, by Lewis Gavin	871,000
Total	$5,797,738

The following statements are taken from Mr. Ford's report, March, 1817, on the part of the joint committee:

"Expense of constructing the Erie canal, $5,000,000. The increase of population in New England at the rate of five per cent. the past twenty years. Transportation from Buffalo to Montreal $30 per ton, and returning $60 to $75. From New York to Buffalo $100 per ton; ordinary time of trip 20 days. The merchants of Oneida county, and counties west, pay annually for transportation, $1,000,000. Advised the organization of a board of Commissioners of a Canal Fund, to borrow $1,500,000 at 6 per cent. Annual revenue, $924,000; expenditure, $547,000. Direct United States tax upon the State, $365,620. J. R. Van Rensselaer proposed to contract for the whole work for $10,000,000 on the plan contemplated by the commissioners, or $7,500,000 and receive tolls for twenty years after one-fourth was completed."

The commissioners made application to Congress for aid, through their President, DeWitt Clinton, and to Ohio, Nov. 10th and 11th, 1816.

Wm. D. Ford, chairman of the joint committee, addressed a communication to Hon. DeWitt Clinton, March 8, 1817, asking

him to plan a system of finance for a canal fund. He replied on the 10th, as follows, viz:

1. Borrow $1,500,000 on the credit of the State, by the creation of a funded debt, with interest at six per cent., principal reïmbursable in twenty years.

2. The said Commissioners shall keep an account of all moneys received for the said fund, (which moneys shall be kept in the treasury,) and shall pay over, from time to time, such moneys as shall be required for the execution of the powers committed to them.

3. The said Commissioners of the fund shall, as soon as the whole or a part of the said works be completed, have power to establish and receive reasonable tolls.

4. The annual application of $60,000 of the moneys arising from auction duties, and the whole of the moneys which the State may derive from the sale of unappropriated lands, shall be pledged for the payment of said debt and the interest thereof. And they shall have power to apply any unappropriated money in the treasury to make good any deficiency or suspension in the payment of said funds.

5. The said Commissioners shall, at the opening of the next session of the Legislature, report a plan of finances for the execution of the whole of said canals, and also of a sinking fund for the extinguishment of the debt.

In this same communication it was stated that 400,000 tons of freight were carried annually on the Hudson river.

Thus DeWitt Clinton laid the foundation of our canal financial system. He estimated that ten million tons annually would be carried upon the canals; that the cost of a ton for transportation from Buffalo to Albany would be $3\frac{50}{100}$.

The first expense of the engineering department was submitted April 2d, 1817, and amounted to $14,462. Cessions of land from 56 persons, were obtained for the canal project, April 1st, 1817.

Total expended for explorations and surveys, up to 1817, $42,957.

Commissioners of Canal Fund Established, and Work Authorized to Commence; Canal Appraisers Appointed, by Act Passed April 15th, 1817.

This Law also retained the present Commissioners in office;

and the Canal Appraisers to be appointed by the Supreme Court; to borrow on the credit of the State a sum not exceeding \$400,000 in any one year; tax salt 12½ cents a bushel; tax every steamboat passenger on each voyage, \$1; to tax real estate within twenty-five miles of the canal \$250,000; the Commissioners to contract for the labor of convicts.

The first ground was broken for the canal at Rome, July 4th, 1817. Mr. John Richardson held the plow that opened the furrow in the commencement of the Erie canal.

At this period the canal project was considered by many an untried and ruinous experiment. Fearful were the lamentations in the Legislative halls, over the miseries of an over-taxed posterity. These evil forebodings, issuing from the capital, were caught up and re-echoed by the timid and narrow minded conductors of the public press. But, to the honor of those great statesmen whose prophetic visions enabled them to look beyond the hour of error, they beheld in the future the sunshine of prosperity.

The report of the Commissioners, dated January 31, 1818, gives details of the system adopted for the construction of the canal. That they decided to complete the middle section first; that they resolved to let out the canals in short sections to contractors; extended the middle section to Utica; decided on a long summit level, and, for accuracy, directed James Geddes to run test levels, connecting the Oneida with Onondaga lakes, and from thence, after connecting with the canal, work east. This was done, and in a distance of over 100 miles only differed 1½ inches on return to Rome. Isaac Briggs was employed between Utica and Rome, as assistant; James Geddes was transferred to the Champlain canal. The first contract was dated June 27, 1817. Fifty-eight miles were put under contract during the year of 1817, wholly on the summit level. One job was completed and settled; the whole labor performed was equal to the completion of 15 miles; "3 Irishmen finished 3 rods of canal, 4 feet cutting, in 5½ days." "On the 58 miles, only one-half mile required puddling."

On the 5th of September, Mr. Geddes commenced a re-examination of the Champlain canal, and the size of canal and locks made the same as the Erie. Five miles were contracted for in October.

The act for incorporating the Chittenango Canal Company passed March 6, 1818. The canal was to be made in 5 years; that the company should be dissolved when the income from tolls should pay all their expenses and 14 per cent. interest.

The act for constructing a harbor at Buffalo, passed April 10, 1818, and for appointing an engineer for the same, at $3 per day.

The act to improve the funds, and provide for the redemption of the funded debt of the State, passed April 21, 1818. This law authorized the Comptroller to sell certain 3 per cent. U. S. stock, and to apply the proceeds to the reduction of the funded debt; the Comptroller to borrow one million dollars, at 6 per cent.; to receive sealed proposals for the same; Governor to appoint a cashier of a bank in New York to issue certificates of stock; principal irredeemable until 1823; a tax of one mill on a dollar; State deposits to be made in any bank in New York that will loan one million dollars.

Extracts from Governor De Witt Clinton's Speech to the Legislature in 1819.

"In the course of next season, the Champlain canal, from Whitehall to Fort Edward, a distance of 23 miles, and the whole of the middle section of the Erie, from Seneca river to Utica, a distance of 94 miles, will be completed and in a navigable condition." "By the act passed April 15, 1817, the Commissioners were only empowered to make the canal between the Mohawk and Seneca rivers, and from the Hudson to Lake Champlain, and therefore it is highly expedient that a law should be passed authorizing the extension of the work. At the present time, a ton can be conveyed from Buffalo to Albany by land for $100, and to Montreal, principally by water, for $25; that when the canal is completed, a ton can be carried for $10; that the trade of the canal will equal that of the Hudson, one-half million tons a year." The following quotation from the same speech will be appreciated, as the counsel and warning of a great statesman: "A dismemberment of the Republic into separate confederacies, would necessarily produce the jealous circumspection and hostile preparations of bordering States; large standing armies would be immediately raised; unceasing and vindictive wars would follow, and a military despotism would reign triumphant on the ruins of civil liberty. A dissolution of the Union may, there-

fore, be considered the natural death of our free government. And to avert this awful calamity, all local prejudices and geographical distinctions should be discarded; the people should be habituated to frequent intercourse and beneficial inter-communication, and the whole Republic ought to be bound together by the golden ties of commerce and the adamantine chains of interest."

The canal was surveyed and located from the Skaneateles outlet to the Seneca river before the middle of July, 1819, and put under contract. Work commenced on the 10th of August, with from two to three thousand men, to the 10th of December. Canvass White and Nathan S. Roberts, assistant-engineers, were employed staking out work; the former ran test levels over the summit level, and aided the Commissioners in fixing the location of the line through Utica, during the year of 1819; and the latter had been employed throughout the middle section, in the year 1816. Benjamin Wright, principal engineer, was, in 1819, still employed upon the middle section, and Marshall Lewis, who had been upon the Erie, was, in 1819, transferred to the improvement of the Seneca river.

The whole amount of actual disbursements up to January 25, 1819, on the middle section was $5,875,49, one-half the estimated cost. Isaac Briggs was employed on the eastern and western sections, to explore and locate lines.

Ephraim Hart was appointed a Canal Commissioner in 1818, in place of Joseph Ellicott, resigned.

Twelve miles of the Champlain canal were completed and settled for up to December, 1818.

Iron culverts were contracted for at $89 per ton delivered; and the whole expense, when put into the work, was, for 3 ft. diameter $500, for 2 ft. $340, and for 1 ft. $170. There were 10 of 3 ft. in diameter, aggregate length 720 feet; and 6 two feet in diameter, aggregate length 321 feet, on the middle section.

The total expenditures in 1817, 1818, and up to March 11th, 1819, were $719,383, of which $147,056 had been expended on the Champlain canal.

Henry Seymour was appointed a Canal Commissioner, March 24th, 1819. On the same day the salaries of the Commissioner was fixed at $2,500. The sum authorized to be borrowed $700,000 yearly; and the assessment of a tax upon lands within twenty-five miles of the canals suspended.

On the 25th of March, the sum to be borrowed was limited to $600,000 yearly. On the 13th of April, the Legislature directed, by concurrent resolution, the survey of the Oswego river to Three River point, and the Seneca river to Onondaga lake. On April 7th, 1819, a law was passed appropriating $12,000 for building a harbor at Buffalo.

By act passed April 7th, 1819, the Commissioners were authorized to borrow a sum, not exceeding in any one year, together with the net income of the canal fund, and with the sums which they were already authorized to borrow, $600,000; also, to open the canal, and extend the same from Seneca river to Lake Erie,—between Hudson river and Fort Edward,—and between the Erie and salt works at Salina; and that there shall be only three Canal Commissioners, at $2,500 salary, after January 20th, 1820.

Middle Section Completed Oct. 22, 1819.

Water was let into the long level, and navigated with great ceremony. The middle section completed was from Utica to the Seneca river 94 miles, and the Salina side-cut 2 miles. The following is an extract from a book written in 1820, by Elkanah Watson, describing the ceremony:

"On the 22d of October, 1819, the first boat sailed on the Erie canal, from Rome to Utica. It was dragged by a single horse, trotting on the embankment, or towing-path. It was an elegant boat, constructed to carry passengers, and was called the "Chief Engineer,"—a compliment to Benjamin Wright. The president and the Board of Commissioners, attended by many respectable gentlemen and ladies, embarked the ensuing day at Utica, with a band of music, to return to Rome. The scene was extremely interesting and highly grateful. The embarkation took place amid the ringing of bells, the roaring of cannon, and the loud acclamations of thousands of exhilarated spectators, male and female, who lined the banks of the new created river. The scene was truly sublime."

The following is a copy of a letter written by an enthusiastic gentleman in Utica, to the editors of the Albany Daily Advertiser, on the same occasion, dated October 22nd, 1819:

"The last two days have presented in this village a scene of the liveliest interest; and I consider it among the privileges of my life to have been present to witness it. On Friday afternoon

I walked to the head of the grand canal, the eastern extremity of which reaches within a very short distance of the village, and, from one of the slight and airy bridges which crossed it, I had a sight that could not but exhilarate and elevate the mind. The waters were rushing in from the westward, and coming down their untried channel towards the sea. Their course, owing to the absorption of the new banks of the canal, and the distance they had to run from where the stream entered it, was much slower than I had anticipated; they continued gradually to steal along from bridge to bridge, and at first only spreading over the bed of the canal, imperceptibly rose and washed its sides with a gentle wave. It was dark before they reached the eastern extremity; but at sunrise next morning they were on a level—two feet and a half deep throughout the whole distance of thirteen miles. The interest manifested by the whole country, as this new internal river rolled its first waves through the State, cannot be described. You might see the people running across the fields, climbing on trees and fences, and crowding the bank of the canal to gaze upon the welcome sight. A boat had been prepared at Rome, and as the waters came down the canal you might mark their progress by that of this new Argo, which floated triumphantly along the Hellespont of the west, accompanied by the shouts of the peasantry, and having on her deck a military band. At nine the next morning, the bells began a merry peal, and the Commissioners in carriages, proceeded from Bagg's hotel to the place of embarkation. The Governor, accompanied by General Van Renssselaer, Rev. Mr. Stansbury of Albany, Rev. Dr. Blatchford of Lansingburgh, Judge Miller of Utica, Mr. Halley, Mr. Seymour, Judge Wright, Colonel Lansing, Mr. Childs, Mr. Clark, Mr. Bunner, and a large company of their friends embarked, at a quarter past nine, and were received with the roll of the drum, and the shouts of a large multitude of spectators. The boat which received them is built for passengers, is 61 feet in length, and 7½ feet in width, having two rising cabins, of 14 feet each, with a flat deck between them. In forty minutes the company reached Whitesboro, a distance of 2¾ miles, the boat being drawn by a single horse, which walked on the towing-path, attached to a tow rope of about sixty feet long. The horse travelled apparently with the utmost ease. The boat, though literally loaded with passengers, drew but fourteen inches water. A military band played patriotic airs.

From bridge to bridge, from village to village, the procession was saluted with cannon, and every bell, whose sound could reach the canal, swung, as with instinctive life, as it passed by. At Whitesboro, a number of ladies embarked, and heightened by their smiles a scene which wanted but this to make it complete."

Cost of the Middle Section.

The original engineer's estimate of the cost of the middle section was $1,021,851. The actual cost was $1,125,983, an increase of a little more than ten per cent. This increase was from change of prism and structures, as stated by the Commissioners. The construction of 35 miles in the vicinity of Cayuga marshes, was greatly retarded by sickness, over 1000 laborers being disabled from this cause, between the middle of July and October. The Salina side-cut, one mile 43 chains long, cost $6,044, being only $44 above the original estimate.

Cayuga and Seneca Canal.

The first loaded boat from Schenectady, 16 tons burthen, passed the newly constructed locks at Seneca Falls, June 14, 1818. This lock navigation extended five miles, built by a company, at an expense of $60,000. The passage of this sized boat was effected through the old company's locks, while the Erie was under construction. The toll charged for passing their locks (cost equal to six miles canal) was 50 cents, 9 cents per ton a mile.

Champlain Canal.

This canal was opened for navigation November 24, 1819, from the Hudson at Fort Edward, to Lake Champlain. The original estimate for this portion was $250,000. By changing its dimensions January 31, 1818, to the same size of the Erie, the revised estimate amounted to $333,000. The actual amount expended up to February 18, 1820, was $232,268 requiring $30,000 to complete this portion, making on $260,000, a diminution of 28 per cent. Twenty-seven miles remained to be constructed from Fort Edward to the end of the Saratoga level, estimated to cost, March 18, 1817, $621,000.

The duty of 12½ *cents per bushel on salt*, nearly doubled the interest on moneys borrowed for the Erie and Champlain canals from 1817 to 1819 inclusive.

At a meeting of the Canal Commissioners, held at Utica, October, 1819, it was resolved to let 63 miles of the Western

and 26 of the Eastern section, the latter being from Utica to Little Falls. Canvass White, engineer, was employed exploring the route between the Genesee and Seneca rivers, in 1819, assisted by Valentine Gill. David Thomas, engineer, was employed the same year in making the survey of Buffalo harbor. The Commissioners, in the report dated February 18, 1820, remarked that, "the novelty of seeing large boats drawn by horses, upon waters artificially conducted, through cultivated fields, forests and swamps, over ravines, creeks and morasses, and from one elevation to another, by means of ample, beautiful and substantial locks, has been eminently exhilarating."

Oswego Canal.

Report of D. S. Bates, January 7, 1820, of his survey for the Oswego Canal. The route was from Salina to Oswego via the Seneca and Oswego rivers. He made the total fall from Onondaga lake to Lake Ontario, 118.91$\frac{3}{4}$ feet, and distance 31$\frac{1}{2}$ miles. The estimated cost of one plan was $299,519, and of another with the canal along the banks of the river and locks inland, $212,599. This latter plan, he urged, would interfere less with the extensive fisheries on the Oswego river, an important consideration, and he advised protection to so large a class engaged in this business. He stated that 1000 barrels of eels were caught annually, with 500 barrels of other fish, at the Oswego falls, and that the income from fisheries (estimating a barrel of eels at $10) on the Oswego river was $30,000 annually. He proposed to construct the canal on the east side of the river.

David Thomas submitted his report of a survey and estimate for a harbor at Buffalo, December, 1819, estimating the cost at $4,000. An act passed March 30, 1820, authorized the Land Commissioners to set apart lots for the salt springs, to receive surrenders, &c. The steamboat tax was repealed and the "North River Steamboat Company" taxed $5,000 a year. The sum of $25,000, arising from the first sales of land, was to be appropriated to the improvement of Oswego river, and to be borrowed at six per cent.

By an act passed April 5, 1820, the Canal Commissioners' salary was changed from $2,500 to $2,000. By an act passed April 12, 1820, the Commissioners were authorized to borrow, at six per cent., $122,500, one-fourth of the same to be expended on the Champlain, and of the balance, one-half on the Western and the other on the Eastern sections.

The law for canal regulations passed April 13, 1820.

The Canal Commissioners' report, dated March 12, 1821, gives the condition of the canals at the close of the year 1820, from which the following is taken:

"The unexpected loss of water on the completed middle section, settled the question of the necessity of feeding the western section from Lake Erie. David Thomas was employed, with assistants, in locating this portion, from May to November. From Genesee river easterly, 51¼ miles were under contract, including the whole distance to Montezuma, except 9 miles; 15 locks, 20 stone culverts, 5 aqueducts and 40 road bridges. Mile boards were placed from Utica to Genesee river, the distance 96 miles.

Tolls were first levied on the *Erie canal*, *July* 1*st*, 1820, and the amount received in that year was $5,244, the Canal Commissioners fixing the rate. $450 for toll was collected from the old canal at Little Falls, in the same year. The Commissioners also appointed six collectors, located and paid them as follows:

FIRST COLLECTORS APPOINTED, JUNE, 1820.

		Salary.
Stalham Williams	Utica	$200 00
Bela B. Hyde	Rome	200 00
Samuel Holladay	Canastota	150 00
Joshua Forman	Syracuse	250 00
Roderick Matson	Bucksville	200 00
Sanders Lansing	Little Falls	62 50

ENGINEER DEPARTMENT AND SALARIES, MARCH 3, 1820.

			Salary.
James Geddes	Engineer		$1,500 00
Benjamin Wright	do		1,500 00
Canvass White	do		1,500 00
William Jerome	do	Expenses and per day,	4 00
David S. Bates	do	do	4 00
Andrew A. Bartow	do	do	4 00
Valentine Gill	do	do	5 00
Marshall Lewis	do	do	5 00
David Thomas	do	do	5 00
Nathan S. Roberts	do	do	4 00
Alfred Barrett	As't Eng.	do	1 00
B. H. Brown	do	do	1 50
John B. Jervis	do	do	1 25
Daniel Judson	do	do	1 75
"	do	when sick	75

Wm. McElroy......	As't Eng.	Expenses and per day,	$2 00
Abraham Ogden......	do	do	2 00
Hiram Tibbits........	do	do	1 00
H. Wright...........	do	do	1 00
Holmes Hutchinson...	Surveyor	do	1 50
Anthony M. Hoffman..	do	do	3 00
Aaron Vedder........	do	do	1 50
Geo. W. Young........	do	do	1 50

The following compliment to the engineers occurs in the Canal Commissioners' Report for 1820:

"In looking back to the numerous difficulties and responsibilities, some of them of an aspect the most disheartening, which surrounded the canals, especially in their commencement, we feel compelled, by common justice, to commend the aid which has been at all times afforded by our engineers. In the selection of all the persons who are now employed by us, under this character, we have been eminently fortunate. But, to the Hon. Benjamin Wright and James Geddes, the State is mostly indebted. They were the first appointed engineers; they have unceasingly, and with improving fitness, devoted their best faculties to the great cause in which they were engaged."

The repairs of the middle section and superintendent's wages cost, in 1820, $16,718. The toll began to be received when half the transportation of the season was accomplished. The canal through, and eight miles east of Utica, was completed in the fall of 1820, Canvass White being the resident engineer on the eastern section. Seventeen miles of excavation of the Champlain canal were completed, south of Saratoga Falls, William Jerome having charge, as assistant-engineer. Boat navigation opened between Forts Edward and Miller in the fall of 1820.

The survey for lowering Jack's reef for draining Cayuga marshes, was directed by a concurrent resolution, February 16, 1821.

William C. Bouck was appointed a Canal Commissioner during the session of the Legislature, in 1821.

Water Proof Lime in this Country

was first discovered by Canvass White, in 1818, and patented by him in 1820. He made the tour to Europe, at his own expense, for the purpose of acquiring information relative to canals. De Witt Clinton, in a letter to a committee, in 1824, stated that Mr. White had been of great use in his operations as an engineer; and that his skill, industry, and integrity, in that de-

partment, furnish strong recommendations to the favorable notice of the State." Benj. Wright stated before the same committee, "That hydraulic lime had been generally used along the canal since 1818 and part of 1819. In 1819, after much persuasion to the Commissioners by the engineers, it was used in all face work of locks and arches, the backing being laid in common lime. When common lime was used it gave evidences of soon failing. I have no hesitation in saying that the discovery of hydraulic cement by Mr. White, has been of incalculable benefit to the State, and that it is a discovery which ought, in justice, to be handsomely remunerated." Mr. Flagg reported from the same committee, "That in 1818, Mr. White, a principal engineer, made the discovery after repeated experiments, and received a patent in 1820; that he had recovered $1,700 in the United States Courts against an infringement by a contractor, and that thirty or forty contractors were liable to prosecution; that 400,000 bushels had been used from 1819 to 1824, which would subject the contractors to a loss of $16,000, if sued; that it appeared from documents that this cement was a mineral; that Mr. White introduced it at great expense, amidst the doubts and fears which operated against its use."

The Canal Commissioners stated in their report for 1820, that they had discovered water-proof lime in the progress of their exertions, in the quarries of Madison, Onondaga, Cayuga, Ontario, and Genesee counties; that it must be pulverized and mixed one-half sand to one of lime.

Sinking Fund.

By concurrent resolution of the Legislature, the Comptroller, A. McIntyre, devised a plan for a Sinking Fund for the extinguishment of the canal debt, January 12, 1821. He took, as a basis for his calculation, a debt of $5,905,456, a revenue of $210,000, and a loan not to exceed $600,000, with the revenues in one year. This extinguished the canal debt in 1842, at which time the revenue was estimated $580,000; the canal tolls, beyond repairs, at $150,000. The Comptroller then remarks that "If these estimates of revenues and of the expense of making the canals, be correct, it results that the canals will be completed in 1830, and that the canal loans will be discharged in 1843."

The act passed February 9, 1821, authorized the Commissioners to borrow, during the years 1821 and 1822, a sum not exceeding

one million dollars in each year; the appointment of another Canal Commissioner; the appointment of nine appraisers, by concurrent resolutions of the Legislature.

The act passed March 9, 1821, authorized the Canal Commissioners to improve the navigation of the Hudson river from Waterford to Troy, and collect tolls.

The act passed April 3, 1821, fixed the salaries of acting Canal Commissioners at $2,500, in lieu of all charges and expenses, and directed that two of them should act as appraisers, repealing the law appointing nine, of February 9, 1821.

From June, 1817, to October, 1821, inclusive, $2,893,500 were borrowed for making canals, the lenders advancing to the canals $91,202 in premiums. The yearly interest amounted to $159,580.

Progress of the Canals in 1821.

Western Section,

The contracts for opening a feeder from the Genesee river and the Rochester aqueduct, were signed June 6, 1821. Twenty miles of canal west of Genesee river, were let July 10, 1821, and on the 15th and 17th, 45 miles more were let, bringing the western section up to the mountain ridge, and during the season 80 miles of the western section were let, and the whole distance from Tonnewanda to Seneca river put under charge of contractors.

The line across the Cayuga marshes was staked out and located May 7, 1821, and let by contract in that month. The construction actually commenced June 15. The number of workmen engaged was from 200 to 700. Quite all the men and contractors were prostrated by sickness during August. Between Seneca and Genesee rivers the following work was completed December, 1821. Fifty miles completed and 28 navigated; 11 stone locks; 31 arched stone culverts; 2 large aqueducts; 3 waste-weirs; 45 road and 23 farm bridges.

Middle Section.

The amount of tolls collected during the season, $23,001, derived principally from the following articles: 44,723 barrels flour; 17,0[illegible]8 salt; 43,078 bushels of wheat; 1,061,844 feet of boards; 71,000 bushels lime; 9,993 lbs. maple sugar; 58 tons of butter and lard; 772 tons of gypsum; 2,500 tons merchandize; 47 wagons and 10 coaches, &c., at the following rates of toll for 1820 and 1821, viz:

First Rates of Toll Established.

On salt per ton per mile (7 bbls. of 5 bush. each a ton)	5 mills.
Gypsum " "	5 "
Flour, meal, all grains, salted provisions, ashes, per ton per mile	1 cent.
Merchandize per ton per mile	2 "
Square and round timber per 100 cubic feet per mile	5 mills.
Boards, plank and scantling per ft. b. m. "	5 "
Shingles per 1000 per mile	1 "
Brick, sand, lime, iron, stone, per ton per mile	5 "
Rails and posts for fencing, per 1000 "	2 cents.
Wood for fuel per cord per mile	1 "
Wood for manufacturing salt	free.
Boats for transportation, per each ton capacity	1 mill.
Boats for carrying passengers, per mile of passage	5 cents.
Staves and heading for pipes, per 1000 per mile	1 "
Staves and heading for hogsh'ds " "	7 mills.
Staves and heading for barrels " "	5 "
All other articles not enumerated, per ton per mile	1 cent.

The number of boats which passed the collector's office, at Rome, was 2,731. Boats navigated, for the first time, the canal from Utica to Little Falls in the latter part of the season of 1821, making the whole length of navigable canal, from Little Falls to Seneca river, including Salina side-cut of two miles, 128 miles.

Eastern Section.

Canal completed and navigated from Utica to Little Falls in September; and the remaining portion contracted for to the Hudson, including all structures. A wooden lock was constructed at German Flats, connecting the canal with the Mohawk, thus making an uninterrupted navigation from Schenectady to Cayuga and Seneca lakes for boats of 16 tons burthen. Messrs. Wright, principal, and White, acting engineers, explored the country thoroughly from Little Falls to the Hudson, and pronounced impracticable the route from Schenectady connecting with the Hudson back of Albany, and located the line via Cohoes and Troy. The location was finally fixed upon by Messrs. Wright, Geddes and White.

Champlain Canal.

In October, the whole canal was ready for the reception of water (except a small piece of embankment at Veghten's creek)

to within one mile south of Stillwater. The survey of Glens Falls feeder was made in 1821, and the route approved by Commissioners. The tolls collected the past season amounted to $1,386. The principal articles transported were, viz: 9,731,962 ft. b. m. sawed stuff; 260,399 cubic feet timber; 3½ tons Congress water; 172,500 shingles; 142,234 hogshead staves.

Samuel Young tendered his resignation as Canal Commissioner on the 16th of April, 1822, and, by request of the Senate, withdrew it on the 17th. The money spent by the Commissioners from April 15, 1817, to January, 1822, was as follows:

M. Holley	$1,799,425 58	
H. Seymour	833,335 70	
S. Young	554,641 19	
W. C. Bouck	1,589 80	
		$3,188,992 27

Progress of the Canals in 1822.

The act for lowering Onondaga lake, and draining the swamp and marsh lands in the town of Salina, and appropriating the sum of $4,500, passed Feb. 28, 1822.

Glens Falls feeder to be made navigable, the extra expense not to exceed $15,000, as authorized by an act passed April 17, 1822, which limited the speed of boats and rafts to four miles an hour.

Two hundred and twenty miles of the Erie canal were completed and navigated in the fall of 1822. In June, of 1822, the rock-cutting through the mountain ridge was assumed and performed by the State; two miles of the worst portion containing 260,000 cubic yards; the earth on top being over twelve feet cutting and 94,400 cubic yards earth excavation.

On the 1st of July following, the Genesee river feeder was completed and the canal filled from it, from Rochester to Pittsford, and navigated the remaining portion of the season.

On the 14th of October, the water was passed in the canal, over the Irondequoit embankment, seventy feet high, which supply from the Genesee river, produced at once active navigation from Rochester to Little Falls, before rendered useless for want of water—Mud creek being the only feeder for the distance between Pittsford and Seneca river. Not being able to complete the canal across Cayuga marshes, a wooden lock connected it with the Seneca river, so that in May, 1822, toll began to be

collected upon the western section. From the incompleteness of this section, the Canal Commissioners decided in June to charge only half the usual rates of toll west of Montezuma. The amount of toll thus collected at Lyons, Palmyra and Rochester, during the season, was $3,286. The canal was so far completed across the Cayuga marshes that boats passed July 30, 1822. The middle section was navigable from April to December, including the eastern section from Utica to Little Falls.

Business of the Canals in 1822.

Tons passed on Erie canal, at Rome, 35,444.

Tolls collected from Little Falls to Montezuma	$57,160 89
do on western section	3,286 00
do on Champlain canal	3,625 44
	$64,072 33

The repairs, superintendence, etc., of middle section cost $8,000.

On the 15th of November, 1822, water was let into the canal, and navigated by boats drawing one and a half to two feet of water, from Little Falls to the flats of Schenectady. There were completed 13 locks, 11 guard locks, 60 culverts, 13 aqueducts, 105 road and farm bridges, and 6 crib dams.

During the fall of 1822, the Champlain canal, together with locks, aqueducts and culverts, were completed and navigated with loaded boats from Lake Champlain to Waterford. Canvass White, engineer, was sent early in the spring of 1822 to lay out the Glens Falls feeder. During the short time navigation was open on this canal, the tolls were $3,625 44 in the season of 1822. The chief articles were 444,058 feet round and square timber, 15,047,681 feet b. m., 854,000 shingles, 20,000 staves, 8,000 hoop poles, 82 tons of merchandise, 8 tons of meal, 33 tons of marble, 30 barrels of whisky, and 1,800 cwt. paint.

Condition of Canal Expenditures and Work,.

The whole amount of canal expenditures		$5,603,386
Estimated cost to complete Eastern section Erie canal	$600,000	
Estimated cost to complete Western section, Rochester to Mountain Ridge	400,000	
Estimated cost to complete Western section, Mountain Ridge and locks	750,000	

Estimated cost to complete Western section, Tonnawanda creek to the lake, including Tonnawanda and Oak Orchard feeder	$250,000	
		$2,000,000
Total cost for constructing and completing Erie and Champlain canals		$7,603,386

This exceeded the original estimated cost, (March 18, 1817,) $1,850,648, accounted for as follows: There was a mistake of 8 miles in the length of canal between Schoharie and Albany, estimated to cost $136,000, and for a descent of 17 feet, (expense of lockage,) $21,250; damages paid for claims of individuals, $100,000; increasing size of embankments, $150,000; changing wooden to stone structures, $100,000; changing Champlain canal to same size of Erie, $290,000; changing the line through the mountain ridge, $200,000; additional feeders, $150,000; opening connection with Salina side-cut and Onondaga lake, $40,000; improving Hudson river, Troy to Waterford, $70,000; interest on canal debt $446,634; to Western Inland Lock Navigation company, $152,718; incidental expenses of Commissioners, $5,254.

By the use of the canal west of Seneca river, the Commissioners, in this report, dated February, 1823, estimated that the market price of wheat had increased 50 per cent.

The following statement shows the collection of tolls upon the Erie and Champlain canals for the season of 1822.

Names of Collectors.	Office.	Amount collected.	Salary collect's	Incidental exp's	Amount of bail.
David S. Bates	Rochester	$271 06½	$40 00	$30 33	$2,500 00
Seymour Scovell	Palmyra	1,726 47½	200 00	82 40	2,500 00
John Adams	Lyons	1,288 97½	200 00	33 40	2,500 00
Roderick Matson	Mentz	21,804 53	500 00	26 75	2,500 00
Joshua Forman	Syracuse	5,333 34	350 00	....	2,500 00
B. B. Hyde	Rome	2,756 71	500 00	....	2,500 00
Stalham Williams	Utica	23,650 79	500 00	60 62	2,500 00
Sanders Lansing	Little Falls	3,615 06	350 00	....	2,500 00
Samuel Lawrence	Whitehall	2,632 00	200 00	....	....
Samuel Hastings	Fort Ann	720 04	200 00	....	....
Peter McIntyre	Fort Edward	100 15	200 00	....	....
S. F. Shepherd	Fort Miller	173 25	200 00	....	....
		$64,072 38			

The collectors' offices were established October 20th. But half the usual rate of toll was charged west of the Seneca river, in consequence of the deficiency of water before completion of Irondequoit embankment.

Canvass White, Engineer, planned and directed the building of the lock and dam between Troy and Waterford, until the 8th of June, when Wm. Jerome took charge. There was a great difference of opinion among the engineers and Commissioners as to the expediency of extending the navigation of the river above Troy.

Progress of the Canals in 1823.

The Commissioners of the Canal Fund were empowered by an act passed March 29th, 1823, to borrow, during the year, $1,300,000, and $120,000 to pay the interest of the canal stock.

The construction of a basin at Albany at the termination of the Erie and Champlain canal, was authorized by an act passed April 5th, 1823, "To construct a sloop lock, and charge toll for the same."

The act for the relief of owners of hydraulic privileges, in cases where dams are erected by Canal Commissioners, passed April 5th, 1823.

By an act passed April 22d, 1823, the Canal Commissioners were authorized to make a survey from the head of Oswego Falls to Lake Ontario, and to furnish an estimate of the cost of completing the Oswego canal, and changing the canal through Rome.

By an act passed April 24th, 1823, the salaries of the Canal Commissioners were fixed at $2,000.

Champlain Canal.

The Champlain canal was completed from Lake Champlain to Albany, September 10th, 1823, and passed loaded boats; and on the 8th October the first boats passed from the west and north through the junction canal, into the tide waters at Albany. The tolls on rafts were double the same carried in boats. There were only 10 boats on this canal in 1821, and 100 in 1823. Water was passed in the new Glens Falls feeder to Sandy Hill. The amount of tolls received was $26,966.87. Over 4,000 tons passed north to Lake Champlain; and 1,180,000 cubic feet timber, 22,426,067 feet b. m., 41,314 bushels of wheat passed south, together with about 1,200 tons merchandise. Numerous petitions were presented for the construction of a canal in lieu of river navigation between Forts Edward and Miller, estimated to cost $350,000.

Erie Canal.

Two hundred and eighty miles navigated Oct. 1. The canal between Lockport and Rochester not finished. From Rochester

to Brockport the canal was completed and filled Oct. 10. The tolls collected on the same amounted to $141. From Brockport to Lake Erie, 26 miles, not completed; the estimated cost to finish this portion was $928,000. The Rochester aqueduct completed, 802 feet long, with 11 arches, 9 of them 50 feet span, 50,000 barrels of lime used. Canal completed from Salina to Seneca river. Articles that passed collector's office, at Rome, during the season, 35,037 tons.

Tolls collected	between	Genesee and Seneca rivers	$20,954 41
do	do	Seneca river and Utica	77,593 26
do	do	Little Falls and Albany	27,444 09
Total			$125,991 76

In May, the canal was extended 22 miles, to Spraker's from Little Falls. The St. Johnsville feeder was finished in September. The canal, between Schenectady and Albany, was completed, embracing 29 locks, and water let in October 1, thousands celebrating the event. From 30 to 40 boats passed the junction lock in 24 hours. The whole expense estimated to fully complete the Erie and Champlain canals, $1,128,000.

Expenditures of Canal Commissioners from April 15, 1817, *to February*, 1824.

Expenses up to and including		1821	$2,004 523 53
do	do	1822	1,184,468 73
do	do	1823	1,941,962 37
do	do	1824	1,785,447 84
Grand total expended by Commissioners			$6,916,402 47

David Thomas was principal engineer on the Western, and Benj. Wright on the Eastern sections of the Erie canal; Wm. Jerome on the Champlain canal. Porteous R. Root was rodman at $12 per month, and John B. Jarvis, Henry Wright and De Witt Clinton, jun., assistant engineers, at $3 per day.

Progress of the Canals in 1824.

Mr. Holley, Canal Commissioner, resigned in April.

On the 12th of April, 1824, Mr. Bowman offered a resolution, in the Senate, to remove De Witt Clinton from the office of Canal Commissioner. It was carried by 18 majority in the Senate, and 30 in the Assembly.

Messrs. Holley, Young, Seymour and Bouck were the only Commissioners to whom public moneys were advanced.

The act passed April 5, 1824, authorized the Canal Commissioners to survey the Seneca river from Jack's reef to Cayuga lake, with a view to reclaim the Cayuga marshes, and improve the navigation of the river, &c.

An act was passed April 10, 1824, authorizing a survey for a canal from the foot of sloop navigation in the St. Lawrence river to Lake Champlain, and appropriating $1,500.

April 12, 1824, an act was passed for selling Grand Island in Niagara river, together with all islands between that and the shore.

An act, authorizing the Commissioners to borrow one million to complete the canals, passed April 12, 1824.

In the season of 1824, 10,000 boats passed the junction of the Erie and Champlain, with a speed of 55 miles in 24 hours, and with passenger boats 100 miles; 3,000 houses were built in the city of New York in 1824, from the impetus given by canals.

Water was let into the canal between Brockport and Lockport on the 8th of September, and on the 25th loaded boats passed, thus making uninterrupted navigation from Brockport to Albany. Between Utica and Albany there were 300 bridges.

Three hydrostatic locks were constructed at Troy, Utica and Syracuse. The tonnage of boats was obtained by measuring in a pond the displaced water that had been previously gauged in the lock.

A boat with 30 tons of merchandise navigating 200 miles of the canal, paid $184, and passenger boat $12. The tolls upon the Erie were $294,546.62 for the season, and on the Champlain canal, $46.214, 45, making a total of $340,761.07. The freight of the Champlain for the season, 1824, was 28,994 tons, and of the Erie canal 157,446 tons. The number of boats that passed daily below the junction averaged 40, between junction and Utica 24, and between Utica and Rochester 16. The following statement shows the additional distance added each year to the Erie canal; also, the tolls on same, viz:

In 1820,	tolls on	94	miles	$5,437 34
1821,	do	94	do	23,000 00
1822,	do	116	do	57,160 39
1823,	do	160	do	105,037 35
1824,	do	280	do	294,546 62

The debt which had been incurred, including the amount required to complete the canals, and pay damages, at the close of the year 1824, was $7,700,000.

Of the tolls collected $\frac{19}{20}$ were paid by citizens of this State.

It was assumed by the Commissioners that the tolls would reach two million in 1836, and four million in 1846.

The capacity of boats in 1824 was from 35 to 45 tons. The tonnage going to tide water was five times greater than that coming from it.

The Commissioners of the Canal Fund calculated, in 1825, that the debt of that year, together with the sum necessary to be borrowed to complete the canals, ($225,965) would, on the 1st January, 1826, amount to $7,693,736, and that by the application of the yearly income, averaging, (after paying expenses of collection, repairs, &c.,) one million and twenty thousand dollars, the said debt would be extinguished in less than 10 years.

The following value and areas of the islands in Niagara river were fixed by the Surveyor General, in January, 1825, viz:

Grand island,	17,381¼	acres at	$48,422 73
Small islands,	502½	acres at	1,542 25
Totals	17,883¾		$49,964 98

The act for the Governor to nominate and Senate to appoint two Canal Appraisers, passed April 20, 1825.

Grand total expenditures by the Canal Commissioners from 1817 to 1824, both inclusive, for the construction of the canals:

1817 to and including 1821	$2,004,523 53½
1822	1,184,468 73½
1823	1,941,962 37
1824	1,785,447 84
February 1st, 1825	1,356,720 18
	$8,273,122 66

Progress of the Canals in 1825.

Erie canal completed October 26th, and water admitted into the canal at Black Rock from Lake Erie. On this day the first boat ascended the Lockport locks, passed through the mountain ridge into Lake Erie, thus making an uninterrupted navigation to the Atlantic, for boats of from 35 to 45 tons burthen. The opening ceremonies were celebrated with unbounded joy and

enthusiasm; cannon, music, and all the festivities that a great national success could invent, were displayed to glorify the occasion. Medals were struck, and sketches of canal scenes imprinted upon earthen wares, to commemorate the event.

To De Witt Clinton's perseverance and efforts, in his official capacity as Governor and president of the Board of Commissioners from 1817 to its completion, not only the commencement and the vigorous prosecutions of the canals are to be ascribed, but also the plan of finance by which they had been advanced to completion.

The following extracts from the daily papers, recording the event, will be read with great interest, as it serves to convey more impressively the high esteem in which the projectors of the canal policy were held at that time by the people.

(From the Buffalo Journal Extra of October 27.)

CANAL CELEBRATION, BUFFALO, OCTOBER 26, 1825.

Yesterday being the day fixed upon for the first opening of the whole line of the Erie canal, our village at an early hour was thronged by the yeomanry of the county, who, alive to the subject, had assembled in vast numbers to witness the attendant ceremonies of starting the first boat. * * * * *

CELEBRATION ODE.

Strike the lyre! with joyous note,
Let the sound through azure float,
The task is o'er, the work complete,
And Erie's waves with ocean meet;
Bearing afar the rich bequest,
While smiling commerce greets the west.
See where the peaceful waters glide,
Through woodlands wild, as if in pride,
To mark that learning makes her home
Where solidude has set her throne.
Strike the lyre! 'tis envy's knell—
Pallid fear within her cell
Shrinks aghast—while truth and fame
On glory's scroll 'grave Clinton's name.
* * * * * *
Strike the lyre! 'tis freedom's song,
While th' red flash, the line along,
Tells to the world with echoing roar,
Matter and space are triumphed o'er!
Gigantic genius led the van
While sturdy toil fulfill'd the plan.
What boundless gratitude is due
To those, whose purpose, ever true,

Pursued their course with daring pride
Till Erie's waves caress'd the tide.
Strike the lyre! should discord's brand
In vain be hurl'd by impious hand,
New York can proudly boast alone
She wove the band—the Union's zone.

Toasts given at the Eagle Tavern.

The completion of the Erie canal—a memorable era in the annals of our State.

The State of New York—she has added another wonder to the world; her posterity, in the full fruition of its blessings, will guard with grateful recollections the rich bequest of their fathers.

De Witt Clinton—the completion of the Erie is the best commentary on his judgment; while contemplating its usefulness, posterity will never fail to associate the name of its projector.

Toasts Drank at the Mansion House.

The Erie canal—it is the work of freemen.

The State of New York—the pioneer of internal improvements.

De Witt Clinton—the adamantine hills sunk down at his approach, and distant oceans are united by his presence.

The Canal Commissioners, engineers, and workmen of the Erie canal—well done, good and faithful servants.

(From the Albany Daily Advertiser, November 2, 1825.)

Grand Entre.

The first boats from Buffalo will make a grand entre to the city this day, at about 10 A. M., as is expected, and will be greeted by the roar of cannon and acclamations of thousands who never expected to live to see our canal completed.

(From the Albany Daily Advertiser, November 4, 1825.)

Canal Celebration at Albany.

Wednesday last was a proud day for the citizens of Albany—a great day to the citizens of the State of New York, and an important day to the Union; for then we had ocular demonstration that the great work of the age is completed, and our inland seas made accessible from the ocean. The auspicious event was commemorated in a style worthy of freemen, feeling thankful for the blessings which a beneficent Providence had bestowed upon them in such abundance.

At 10 o'clock the "Seneca Chief," with the Governor, Lieut. Governor, the Buffalo, Western, and New York committees on board, came down in fine style, and the thunder of cannon proclaimed that the work was done, and the assembled multitude made the welkin ring with shouts of gladness. It was not a monarch which they hailed; but it was the majesty of genius, supported by a free people, that rode in triumph and commanded the admiration of men stout of heart and firm of purpose.

Mr. William James, chairman of the committee of the citizens of Albany, delivered an address, which, for sound sense, strong ideas, and a clear and lucid exposition of the advantages that will result from the completion of our great works of internal improvement, is worthy of high commendation.

Extracts.

The project was grand and sublime. The difficulties appeared so formidable to many of our best men as to impress a belief of its utter impracticability. The estimates of cost made by its advocates were not more than five per cent. on the calculations of many of its opposers, who affirmed that the United States could not accomplish the work in twenty years. The parties for and against the commencement of the work were distinctly identified and well known; all appeared to act from duty and honest convictions. The talents of the State were brought under contribution in the controversy. The influence of patronage and power in high places, united with a host distinguished for their talents and respectability, was brought against the measure. They were met by the intrepid reasonings and persevering ardor of powerful advocates, who adhered to their first calculations, and enlightened and convinced the people by clear and lucid expositions, reports, and memorials on the subject, which identified a leading individual, who for years had been known as the author of luminous appeals, and addresses to the people of this State, on subjects of improvement in agriculture, manufactures, and commerce, and to have early embarked his reputation and influence, with ardor and power of highly gifted and scientific mind on the canal project. Considered by friends and foes to the measure to be a center to its advocates, he was peculiarly subject to the sarcasm and virulence of the opposition, who stigmatized the estimates and calculations as absurd, their data fallacious, and the motive and object of the persevering and influ-

ential promoter to be sinister and base. He was charged by the opposition with all the evils and profligate waste of public expenditures, and with the disgrace of anticipated failure. To hazard a reputation, so exalted by talent as to reflect credit on the nation, and a character which had been so long and so closely interwoven with the prosperity and dignity of the State, to such awful denunciations, required a mind not only conscious of its own strength and integrity, but of that decision and firmness which eminently distinguished De Witt Clinton. He had been fortunate in associates, by whose exertions and influence the law was passed; and under a system of finance which he proposed, and the intelligence and liberality of subsequent Legislatures, the great work has advanced to completion, giving to the world a practicable example of the proverb, "There is that that scattereth, yet increaseth." * * * * *

Every section of the canal will present to the philanthropist scenes creating sources of wonder and delight, exhibiting the power of mind over matter, and evidencing this country's greatness. He will indulge the pleasing expectation that a bold, hardy, and enterprising population will extend the empire of the Republic, disperse "the shades of the wilderness," and plant monuments of civilization and refinement around the great waters of Michigan, Huron, and Superior. * * * *

It might be consistent with the occasion, that we should review the striking and particular causes of our advancement in power and wealth, and also contrast the intelligence, liberality, and energy exhibited by the Republic, in this great work, with that of other nations. Such a course is due, and would reflect merited praise on our scientific engineers, who have laid out the courses, directed the levels and all the works; and also the Commissioners and agents who have had charge and superintendence of their execution. * * * * * * * *

The cost and expenditure of the canal are indeed trifling when compared with the millions lavished on ostentatious ambition of monarchs and their favorites, and the labor is incomparably less than that bestowed upon the construction of pyramids, erected by the slaves of superstition for mausoleums to contain the dust or sarcophagi of their tyrants. * * * * * *

Toasts Drank upon the Occasion.

Internal improvements—the true sources of national glory and happiness.

Canals—The surest guards against the calamities of war. They constitute the strong ligaments that bind us together in united energy and strength.

By Governor Clinton—The love of country. May it ever rise superior to the spirit of party and personal consideration.

By Lieut. Governor Tallmadge—Hail! to the waters of the Erie, which have this day come to greet the Hudson. They have been brought by the resources and enterprise of a single State, through rock and over hills. May they never be burthened with a tonnage duty to the United States.

* * * * * * * * * * * *

Thursday morning, at ten o'clock, all the steamboats and canal boats from Lake Erie took their departure for New York.

Finances of the State.

On the first January, 1825, the finances of the State stood as follows:

Canal debt ($4,524,270 at 5 per cent. and $2,943,500 at 6 per cent.)	$7,467,770 00
Canals cost (adding $494,773 tolls and W. J. L. N. canal)	9,323,789 00
Estimated amount to complete, including claims and damages	800,000 00
Revenue of Canal Fund, for 11 months	592,497 00
Of which there is included for canal tolls	289,320 00
Estimated revenue of Canal Fund for 1825	717,500 00
Annual interest on canal debt	402,823 00
Whole amount tolls received from commencement to 1825	494,733 00
Annual surplus to be applied to canal debt	610,000 00
Total expenditures by Canal Commissioners from 1817 to 1825	8,273,122 00

Staetment of Canal expenditures in detail from April 15, 1817, *to* 1824, *inclusive.*

Engineer department	$247,644 71
Superintendent of repairs and work	118,194 27
Collectors of tolls and assistants	23,331 00
Canal Commissioners' salaries, traveling, &c	70,531 67
Agents	45,772 53
Appraisers	3,427 18
Lock tending	5,782 00
Damages paid to individuals	80,170 69

Building fences, removing buildings and fences, use of lands	$68,997 48
Repairs of canals	140,322 04
Miscellaneous expenses other than for construction	18,149 00
Total	$822,322 57

For construction proper—Canals.

Section work	$5,448,345 09
Mechanical work	1,892,208 00
Feeders	101,647 00
1 hydrostatic lock	8,600 00
Total expended on canal from Apr. 15, 1817, to Feb. 16, 1825	$8,273,122 66
Total expended by the Commissioners for the year	1,101,250 48
Total expended on Erie and Champlain, Jan. 1, 1826	$9,474,373 14

ACTUAL COST PROPER OF ERIE AND CHAMPLAIN CANALS.

The Commissioners of the Canal Fund stated, that from $9,474,373 should be deducted $1,621,274 for pay of engineers, Commissioners, feeders, damages, repairs, Black Rock harbor, lowering Onondaga outlet, Salina and Onondaga side-cut and locks, Waterford and Troy side-cuts, locks and dams, and channel in river, Glen's Falls feeder, making the actual construction cost $7,853,099 equal to 18,136 per mile, the aggregate length being 433 miles.

The admission of water into the canal at Black Rock, Oct 26, gave a depth of from 5½ to 6 feet, above bottom, from Buffalo to Lockport, as originally located by David Thomas.

The water was drawn eastward by a declivity of one inch to a mile. The Lockport locks overcome an ascent of 60 feet.

Collectors were first appointed at Buffalo Oct. 1. The tolls collected on the Erie for the season were $492,664, and on the Champlain $73,557.

Whole number of tons to tide water	185,405
do do from do	33,669
do passengers	40,000

Cayuga and Seneca, and Oswego Canals.

The construction of the Cayuga and Seneca, and Oswego canals was authorized by the act of April 20, 1825, which appropriated $150,000 for the former, and $227,000 for the latter. The survey and estimate for the former were made by David Thomas, and for the latter by Holmes Hutchinson. Both were put under contract in June and July. The act of April 20 is known as the great canal bill that authorized the surveying and estimating of 21 canal routes, embracing an aggregate length of over 1,700 miles, and appropriating therefor $12,500; 900 miles were surveyed during the year. The Chenango, Genesee Valley, Black River and Chemung canals were included in this law.

The Canal Commissioners reported to the Senate, under a call, that, in consequence of the completion of the Erie and Champlain canals, the services of the following engineers could be dispensed with:

James Geddes, principal engineer.
Nathan S. Roberts, principal engineer.
David S. Bates, do
Holmes Hutchinson, resident engineer.
Porteous R. Root, assistant engineer and superintendent.
Charles T. Whippo, do do
Jno. T. Clark, inspector and weigh master.

Mr. Allen from the committee on canals, reported in favor of the construction of the Chenango and Chemung canals. The former was estimated to cost, including damages to hydraulic power, $742,478, and the estimate of the probable revenue per year at $51,800. From Utica to Binghamton its length was 90 miles.

The Chemung canal, from Seneca lake to Newtown, (Elmira,) was estimated to cost $240,000, including a navigable feeder. Length of canal and feeder thirty-one miles, and the estimate of probable revenue $20,757 per year.

Progress of the Canals in 1826.

During the year the construction progressed upon the Oswego, the Cayuga and Seneca canals, the Glen's Falls feeder, and the Champlain from Fort Edward to Saratoga.

Oswego Canal.

Three large dams were built across the Oswego river, with several locks and the completion of river improvement from Onondaga lake to "Three River Point." The distance from Salina

to Oswego 38 miles, with a fall of 123 feet. Total estimated cost at contract prices, in 1826, $437,000. Mr. Weston pronounced the construction of this canal as presenting "obstacles almost insurmountable," and altogether deemed it impracticable. The Cayuga and Seneca canal was all put under contract, except that portion from Waterloo to the Lake.

Erie and Champlain.

Of the Erie canal about 250 miles were protected by stone and timber, at an expense of $800 per mile—the completion of Limestone creek feeder, and feeder at Rome,—rebuilding eighty bridges. The canal from Fort Edward to Fort Miller substituted for river navigation, estimated to cost $170,000, nearly completed.

Rates of Toll.

The Inland Lock Company charged in 1814 for passing locks at Little Falls, German Flats and Rome, $5.75 to $5.90 per ton.
Rates on turnpikes in 1826 was 1½ cents per ton per mile.
do do Erie canal in 1826 do 5 mills do do
do to pass Cayuga bridge 30 cents do do
do Erie canal, one barrel flour on 100 miles was, in 1826, 12c.
do do do do bushel wheat do do do do 3c.

Engineers.

David Thomas, engineer in charge of the Cayuga and Seneca, and William Jerome the Oswego canals.

Canal Board created by Act, passed April 18th, 1826.

Black River Canal.

Mr. Dagan presented petitions for the construction of the Black River canal, Feb. 3d, 1827.

Progress of the Canals in 1827.

At Fort Plain a new lift lock was completed. The dam at the head of Genesee river feeder, was raised fourteen inches. The canal from Fort Edward to Fort Miller was completed and in use. The Oswego canal unfinished from great sickness among the laborers. Almost the whole of the Cayuga and Seneca canal was re-let May 10th.

The tolls collected on the Erie canal during the season, were $786,244.64, and on the Champlain canal, $72,833.84, leaving an excess, above all expenditures for maintenance, of $271,448.27. The Canal Commissioners met January 7, and organized under

the new law, passed the last winter, reducing the acting Commissioners to two.

During the session of the Legislature, petitions were presented for the construction of the Chenango, Chemung, Black River, Genesee Valley, Crooked Lake, and Cayuga Lake Inlet canals, also for the Oneida Lake canal.

There were one hundred and twelve lock tenders on the Erie and Champlain—pay, $20 per month.

Progress of the Canals in 1828.

Oswego Canal

Was completed and navigation opened December 10th. This canal was to have been completed in July, but extraordinary sickness and floods delayed.

One half the canal consisted of artificial channels, and the other was slack water navigation, Holmes Hutchinson's original plan having been changed to locks and dams. The structures consisted of 22 bridges, 7 culverts, 1 aqueduct, 2 waste weirs, 8 dams and 14 stone locks. Cost of construction, $525,115\frac{37}{100}$.

Cayuga and Seneca Canal

Was completed and navigation opened November 15th, from Seneca lake to Montezuma, and collection of tolls commenced. It had 11 locks—83½ feet lockage. Cost of construction, $160,396\frac{78}{100}$, which, together with $53,603\frac{53}{100}$ paid the Seneca Lock Navigation Company, made the actual cost $214,000\frac{31}{100}$—$7,500 per mile—which greatly exceeded David Thomas estimate in 1825, at $150,000. The locks were all built of wood. The Cayuga inlet was re-surveyed and put under contract in May.

Black River Canal.

Alfred Conger made a survey and estimate of this canal, for a company, Nov. 20, 1828, estimating the cost at $433,571. Its length was assumed to be 20½ miles, 10 of which were artificial, and 10½ natural channels. The structures were 11 locks, (73½ feet lockage), 19 bridges, 2,710 lineal feet towing-path and bridges, 5 safety gates, 5 dams, 6 culverts, 17 miles fence, 3 lock houses and 1 collector's office.

Erie and Champlain Canal.

Two new weigh locks were built in the place of the old hydrostatic locks at Syracuse and Troy. Three locks were built at Fort Ann, taking the place of old ones built of quick lime, be-

fore the discovery of water lime, in 1818, by Canvass White, and by the Canal Commissioners, in the quarries, in 1820.

Total expenditures by the Commissioners during the year	$1,002,287
Total revenues from all sources from canals	1,233,435
Including for tolls	838,412
Number of tons arriving at tide water	181,604
do departing from tide water	32,506
do boats arriving and departing from Albany	14,478
Whole number of tons carried	214,110

Chenango Canal.

Surveyed and estimated by Nathan S. Roberts and Holmes Hutchinson, Sept. 17 and Jan. 22, 1838, at the expense, and under the direction of, petitioners. Mr. Roberts reported the supply of water, and Mr. Hutchinson the construction—estimated to cost $944,775. The estimated revenue by the canal committee was $173,640. Mr. Hutchinson made the length 92¾ miles; summit level 706 feet above the Erie, and 303 above the Susquehannah; size the same as the Erie.

Progress of the Canals in 1829.

It was found that wooden structures required to be renewed every eight or ten years. Weigh lock at Utica completed. Canal across Cayuga marshes was deepened, caused by improvement in Seneca river, at "Jack's reef." Cayuga inlet canal completed Sept. 1st.

Total expended for repairs on the Erie	$175,405
do do Champlain	55,958
do do Oswego	12,871
do do Cayuga and Seneca	8,038
Total amount of tolls collected on above canals	861,302

Construction Chenango canal authorized by act of March 24, 1829, of the same size of the Erie canal; the locks on Holmes Hutchinson's plan. This law also authorized a re-survey, and David S. Bates was selected by the Commissioners, who submitted his report, January, 1830. He estimated the cost at $992,307.

Chemung and Crooked Lake Canals.

Surveys and estimates of Chemung and Crooked Lake canals were submitted by Holmes Hutchinson, Nov. 12, 1829. He made the Chemung 22½ miles long; summit level 441 feet above Seneca

lake, and 47 above Chemung river, and its estimated cost $179,004, and the feeder, $112,536, making both together, with contingencies, $331,125; and the Crooked Lake canal, eight miles long, 27 locks, 270 feet lockage, at $119,198. Both were authorized to be constructed, the Chemung by act of April 15, 1829, appropriating $300,000, and the Crooked lake by act of April 11, 1829, appropriating $120,000, with composite locks, and both the same size of the Erie canal; the Chemung locks to be of wood, one lock being estimated by Holmes Hutchinson to cost $1,617.

David Thomas was designated by law to superintend the improvement of Seneca river for draining the Cayuga marshes. The channel at Jack's reef was stated by Commissioners to have lowered Cross lake 5 feet, at Mosquito Point 4 feet, at Bluff Point 3 feet, and at Montezuma 2 feet. Whole expenditures for this purpose $98,371.

January 26, 1830, O. W. Childs submitted his report for lowering Oneida lake, and improving the river for navigation. He made the length of Oneida river $19\frac{1}{4}$ miles, and its fall $9\frac{60}{100}$ feet. He estimated the cost of the improvement for canal navigation at $86,398, and for steamboat at $59,923. He calculated that a channel 100 feet wide, and 4 feet cut, would lower the lake from 15 to 21 inches. The above work was authorized April 30, 1829, and provided for a re-survey.

May 4, 1829, the lowering of Seneca lake was authorized to the level with the outlet, one-half mile from the lake—the reduction of the bottom of canal, from the outlet to Geneva, to correspond. The inlet at the head of the lake was to be deepened 18 inches, and the width at bottom to be 60 feet.

Col. De Witt Clinton, Jr. was the engineer in charge of the survey of the Susquehannah and Chemung rivers, and of the connection of Otsego lake with the Erie canal, by canal or railroad. He submitted a very able and scientific report on the same, January 27, 1830.

Progress of the Canals in 1830.

Total amount tolls collected on all the canals..	$1,056,799 00
Total amount expended for repairs............	229,850 00
There were 80 levels on the Erie canal; number of locks, 84.	
Total number of boats arriving at and departing from Albany, 12,890.	

Total expenditure by Canal Commissioners from 1817	$10,606,514 48
Total expenditure by superintendents from February, 1826	1,124,558 84
Chemung canal put under contract in April, to be completed the following October. Estimated cost at contract price	291,831 00
Crooked Lake canal put under contract. Estimated cost at contract price	95,820 00

The amount of property sent to and from the country west of this State increased 100 per cent. during the year.

H. S. Sargent submitted his report for improving Chemung and Susquehannah rivers, March 17, 1831.

The Legislature was petitioned January 19, 1831, for an act to incorporate the Oneida Lake Canal Company. The canal was estimated to cost $30,000. It was stated that land had depreciated one-half in value since the diversion of trade to the Erie canal. Fifty-one feet lockage, and length of canal three miles.

Survey and Estimate Black River Canal.

February 28, 1831, Holmes Hutchinson, in answer to a resolution, November 24, 1829, submitted his report of the survey and estimate of the Black River canal, and argued the practicability of using inclined planes instead of locks. From this report the following is taken: The whole rise and fall from Rome to the Black river 1,078 feet; 10 inclined planes to be constructed to overcome 685 feet, and 39 combined locks for remaining elevations. Length from Rome to High Falls 36 miles; and 40 miles of river to Carthage. Canal to be supplied from Black river; estimated to afford at Smith's mill 20,000 cubic feet per minute. Feeder from Black river to the canal nine miles long. The supply of 20,000 cubic feet was for ordinary low water, and estimated four times more than would be required for the canal. The size of feeder and canal, 20 feet wide on bottom, 36 feet on surface, and 4 feet deep; the banks to be 3 feet above water line, and 8 feet wide on berme, and 12 feet towing path. The river to be improved by lock and dam; and for such improvement at an estimated cost of $12,000. The estimated cost of the canal at $602,544.

The inclined planes were intended for great elevations of not less than 45 feet. Inclined planes were used with success on the Morris canal. The boat is introduced from the upper level, after

filling the lock through the paddle gate; this water raises the lower gate to its place, and the lock fills to a level with the water in the canal. The boat is then floated in, the upper gate shut, and by discharging the water from the lock, the lower gate falls by its own weight to its place, and the boat settles down upon the cradle, and is ready to move down the plane. There is a friction break on the rim of the water wheel to regulate the motion of the car, and also the common governor, turned by a bevel wheel on the arms of the car wheel; thus any accelerated motion of the car wheel causes the balls of the arms to fly out and disengage wedges that fall before each wheel, and cause the stoppage of the car in any part of the plane. The plane, at the summit, rises one foot above the water in the upper level. The moving power is a water wheel twenty-four feet in diameter. In the descent, a boat moves at an average of twelve minutes for a lift of seventy-five feet, and fourteen minutes for the whole operation.

Progress of the Canals in 1831.

Beyond the ordinary repairs there was constructed and rebuilt in part on all the canals, in 1830 and 1831, 226 bridges, 20 aqueducts, 4 culverts, 28 waste weirs, and 75 miles walling and docking.

Total expended for repairs $194,405, for nine months, the law of last year fixing the fiscal year.

Amount of tolls collected	$1,223,801 99

Dam across Chemung river, completed November, 645 feet long and 7 feet high.

Whole number of boats that arrived and departed from Albany, 14,963.

Total canal stock issued from 1817 to 1831 inclusive	$8,802,033 99
Total canal debt from 1817 to 1831 inclusive	8,055,645 86
Total canal expenditures by Canal Commissioners 1817 to 1832	10,768,634 85
Total canal expenditures by superintendents, 1817 to 1832	1,305,333 69

Progress of the Canals in 1832.

Chemung canal and feeder completed September 10, 1831, and cost in detail as follows:

1,175,963 c. yds.	excavation,	average price	$9\frac{8}{10}$ cents	$115,263 70
533,912 do	embankment	do	$10\frac{2}{10}$ do	51,399 02

7,220 c. yds. slope wall	$3,468 54
28,775 lineal feet docking	1,551 24
6,303 rods fence	3,151 50
1,423 do removed	241 91
52 locks	84,131 59
76 bridges	8,110 23
1 dam across Chemung river	5,721 26
3 aqueducts	3,697 13
6 waste weirs, 5 culverts and 4 lock houses	2,199 00
Add engineering department	12,800 00
Removing buildings, piers and roads	22,860 39
	$314,395 51

Holmes Hutchinson made a complete survey and maps of the Erie canal from Canastota to Hudson river; also of the Champlain canal, embracing all the lands owned by the State. The same were placed on file in the Canal Department.

Oneida Lake Canal Company, incorporated March 22, 1832. The capital stock was $40,000, divided into shares of $25 each. Montgomery Hunt, Jno. E. Hinman, Samuel S. Breese, Wm. Fisk, I. S. Spencer, Henry Monroe and Nathan J. Stiles were the commissioners to open the subscription, at Utica; they were to receive $2 per day for such service. The company was to construct and maintain the canal for fifty years, to make it the same size as the Erie, and charge the same rates of toll.

Cost of all the Canals, including Interest on Loans, up to Date of Completion, March 23, 1833.

The committee on canals, by an order of the House, signed by S. M. Stilwell, chairman, reviewed the whole canal policy and expenditures of construction, with great ability and eloquence, and gave the following condensed statement:

CANAL.	When commenced.	When completed.	Length in miles.	Number of locks.	Feet of lockage.	Total cost including interest on loans, engineering and com'rs pay.
Erie canal	1817	1825	363	84	689	$9,027,456 00
Champlain canal	1817	1825	64	21	183	1,179,872 00
Oswego canal	1826	1828	38	14	123	565,437 35
Cayuga and Seneca canal	1827	1829	23	11	83½	236,804 74
Chemung canal and feeder	1831	1832	39	54	516	314,395 51
Crooked Lake canal	1831	1833	8	27	270	136,101 17
Chenango canal	1833	....	97	116	1,021	....
			632	327	2,885½	$11,460,066 77

The whole cost, $11,460,066.77, includes interest on sums borrowed.

Total cost *improving Hudson river* between Waterford and Albany, as stated by Comptroller, from 1817, $98,706.75.

Expenditures by Canal Commissioners and Superintendents, from April 15, 1817, *to September* 30, 1832.

	By Commissioners.	By Superintend'ts.
Erie and Champlain canals	$9,847,620	$1,571,924
Oswego canal	538,356	45,661
Cayuga and Seneca canal	172,697	22,666
Chemung canal	298,538	
Crooked Lake canal	71,766	
Totals	$10,928,978	$1,640,252

Expenditures by Commissioners of the Canal Fund, from April 15, 1817, *to September* 30, 1832.

To Canal Commissioners	$9,809,304
Interest on Canal debt	4,150,553
Western Inland Lock Navigation Company	152,718
Myron Holley's notes	17,155
Weigh masters, collectors, printing, &c	84,767
Superintendents of repairs	1,561,004
Extinguishment of canal debt	750,535
Loaned and invested for the State	1,687,351
Total	$18,213,389

The cost of transportation on a bushel of wheat in 1832, from Albany to Rochester was $22\frac{4}{10}$ cents; for a barrel of flour 80 cents, including toll.

Progress of the Canals in 1833.

Crooked Lake Canal Completed,

October 10, and navigation opened October 21, 1833. *Cost of construction* $133,292.70; $3,039 were expended for repairs and collection, up to January 1st, 1834.

Chenango Canal.

Jno. B. Jervis was appointed chief engineer of the Chenango canal April 12, 1833. Under his direction surveys and estimates

were made of 175 miles of canal and feeders, and the drainage of nine reservoirs. The surveys were completed September 27. He was assisted by J. D. Allen, Isaac W. Crane, P. R. Root and A. Barrett, resident engineers. He made four estimates on different plans of locks, and two termini, and estimated the cost of present termination and locks at $959,222. The quantity of water required to supply the same was 3,243 cubic feet per m.

The basis used for drainage, the fall of rain that would descend into the reservoirs; in England this was computed to be one-third; Jno. B. Jervis used one-fifth. *Its construction was authorized* February 23, 1833, one million appropriated.

Holmes Hutchinson examined and reported the failing condition of the Rochester aqueduct, and the Commissioners decided to rebuild it.

Wm. Jerome examined, in October, the feasibility of obtaining an increased supply of water for the Jordan level, and reported in favor of the Owasco outlet. Fred C. Mills afterward examined the same and estimated the cost to make it navigable.

Reduction of toll by the Commissioners of 28½ per cent. going to tide-water and 14¼ per cent. going from.

Auction and Salt Duties.

The Commissioners of the Canal Fund stated that enough had been received from this source to pay the interest upon all the moneys borrowed for the Erie and Champlain, up to September 30, 1833, amounting to $5,913,621.

De Witt Clinton, jr. proposed to improve the Hudson by longitudinal dams and jetties.

PROGRESS OF THE CANALS IN 1834.

Total expended by Canal Commisioners from April 15th, 1817	$11,296,433
Total expended by superintendents from 1826	2,502,005
Total amount of tolls received from 1820 to 1834, inclusive	10,730,097

Descent in canal from Lake Erie to Rochester, observed:

Lake Erie to Tonnawanda,	8	miles,	descent	1 inch	per mile.
Pendleton,	12	do	do	2½	do
Lockport,	7	do	do	1½	do
Rochester,	65	do	do	1½	do

Making total distance 92 miles, and total descent 146 inches.

This descent in the surface was necessary to supply the canal to Clyde, 154 miles.

Rebuilding structures on the Erie: 107 bridges, 48 lock gates, 197 culverts and gates, 11 waste weirs, 27 miles walling and docking, and the Troy weigh lock, rebuilt.

Surveys and maps of the Erie, Champlain, Oswego, Cayuga and Seneca canals, by Holmes Hutchinson, were approved and placed on file, Sept. 6th, 1834, in the Comptroller's office. The work was done by contract. During the season Mr. Hutchinson also completed surveys and maps of the Chemung and Crooked Lake canals and Glens Falls feeder.

Chenango Canal.

Work was commenced, and its estimated cost revised by O. W. Childs and I. W. Crane, under the chief engineer, John B. Jervis. Work between Sherburne and Green was put under contract in July, 1834. Land damages in estimates not included.

Estimated cost at engineers' prices, feeders and reservoirs	$1,960,456
Estimated cost at contract prices, feeders and reservoirs	1,859,849

Estimated cost of improving Glens Falls feeder, by H. Hutchinson, $127,829.

Total expenditure by Commissioners of Canal Fund from 1817, $20,241,620.

First law towards enlargement of the Erie canal, passed May 6th, 1834, entitled "An act to improve the canals of this State."

This law authorized the Commissioners to construct a second set of lift locks from Albany to Syracuse, of such dimensions with the canal as they should deem proper, and to take the waters of Nine-mile creek; also to reconstruct the Rochester aqueduct, and construct sluices around locks.

Holmes Hutchinson was employed under this law to make the surveys and estimates, and Nathan S. Roberts to rebuild the Rochester aqueduct. The latter submitted his report Dec. 26th, 1835, estimating the cost for 40 feet waterway at $242,890. Mr. Hutchinson submitted his report Jan 26th, 1835, estimating the cost of work embraced under his charge at $1,077,582. The size of proposed locks was 100 feet between quoins, width 15 feet, and thickness of walls 6½ feet. The average estimated cost of

one lock (53 in number) was $17,670. The estimate embraced only the enlargement of structures.

Analysis of prices for the above estimate:

Quarrying per cubic yard	$2 25
Cutting $4\frac{15}{100}$ feet, each cubic yard of face at 50 cents	2 08
Dressing backing, $4\frac{15}{100}$ feet, each cubic yard at 10 cents	0 83
Cartage and freighting, each cubic yard	1 75
Laying into work, do	2 00
Lime and sand, do	0 50
	$9 43

Under act of April 22d, 1834, the Black River canal was resurveyed and estimated by Timothy B. Jervis, appointed May 22d. He made the total lockage 1,083½ feet, length of canal and feeder 46¾ miles, river 40 miles, and the aggregate cost, adopting two inclined planes, combined locks of stone and single of wood, $907,802, and all the locks stone at $1,068,437. Summit level above the Erie, 696½ feet; depression below High Falls, 387 feet.

Progress of the Canals in 1835.

Scientific Reports submitted during the year, addressed to the Commissioners.

1st. By John B. Jervis, Holmes Hutchinson, and Fred. C. Mills, upon relative cost of transportation on canals and railroads.

The following document, transmitted to the Legislature by the Canal Commissioners, combines so much scientific information, and exhibits such depth of research in the subjects treated, that it seems but an act of justice to give it here entire.

REPORT

Of the Canal Commissioners on a resolution of the Assembly of the 23d February, 1835, *relative to the cost of canals and railroads.*

The Canal Commissioners, in obedience to a resolution of the Assembly, under date of the 23d ultimo, requesting them to report "at as early a day as conveniently may be, a statement showing the average relative cost per mile of canals and railroads, the average relative expense annually of repairs and superintendence, and the average relative charges per ton, or other given quantity for transportation; and also, whether in their opinion, any, and what articles of produce, merchandise, or manufacture, can or cannot, having a due regard to the saving of

time, as well as other circumstances, be more advantageously conveyed on railroads than by canals, with the reasons for their opinion, and such observations on the general subject of this resolution, as they may deem appropriate to guide the action of the Legislature in reference thereto," respectfully submit the following report:

The subject submitted to the consideration of the Commissioners, is interesting in its character, and of some public importance. The comparative cost of constructing railroads and canals, the comparative cost of transportation, and the comparative expense of superintendence and repairs, are subjects which have occupied a large share of public attention; and respecting which, many speculative opinions have been advanced. At one period, the public were assured with some degree of apparent confidence, that railroads would supersede canals; and it will, no doubt, be recollected by many, that inquiries were made as to the probability of converting the Erie canal into a railroad.

Experience has gradually developed the relative utility of canals and railroads for the transportation of property. We think the period is not distant, if it has not already arrived, when the superior advantages of a canal over a railroad, as a means of conveying property, will be indisputably demonstrated.

It is believed that it will not be difficult to show, that the expense of transportation on railroads, is very materially greater than on canals. In addition to this, there are other important considerations in favor of canals.

A canal may be compared to a common highway, upon which every man can be the carrier of his own property, and therefore creates the most active competition, which serves to reduce the expense of transportation to the lowest rates. The farmer, the merchant, and the manufacturer, can avail themselves of the advantage of carrying their property to market, in a manner which will best comport with their interest.

Much of the property which passes on the canals, is carried by transportation companies; but the largest portion is carried by individuals and small associations. The individual who becomes the carrier of his own property, has the advantage of paying nearly one-half of the expense of transportation, in the regular course of his business; and the cash disbursements often do not much exceed the payment of the tolls. To the farmer,

the profits on return freight in many instances give a full indemnity for the expense of taking his cargo to market.

On railroads the proprietors must necessarily be the carriers; and this is the general practice.

It appears that in the State of Pennsylvania an attempt has been made to permit an indiscriminate use of railroads. On this subject the Canal Commissioners of that State, in their last annual report, remark as follows: "Before quitting the subject of railways, the Canal Commissioners take occasion to remark, that the experience of the past season has convinced them that these roads, either as it regards revenue, facilities to trade or general accommodation, will not answer public expectation, if thrown open like public highways, to be used indiscriminately. Every person who has paid the least attention to the transportation upon them since they were opened, must be convinced that an unrestrained and indiscriminate application of motive power is attended with danger, delays, and interruptions. Safety, regularity, and punctuality, must first be secured before those important links in our great chain of improvements can fully answer the purpose for which they were designed, and the Board are decidedly of opinion that this desideratum is only to be obtained by the Commonwealth furnishing all the motive power, and directing its application."

There is some difficulty in furnishing an accurate comparative statement of the cost of constructing canals and railroads. The character of the country in which a canal or railroad is situated, and the manner in which they are constructed, have an important influence in determining their cost; and unless the prominent circumstances which have a bearing on this question are understood, it would be difficult to do more than furnish an approximate estimate.

To furnish a statement of the actual cost of several canals and railroads, with a brief allusion to the prominent features which have a bearing on the question of cost, is the best evidence which can now be furnished, in answer to that branch of the inquiry.

The relative annual expense of superintendence and repairs, is not the subject of estimate on any fixed data; but must rest on experience. This expense would depend on circumstances which are hardly similar in any two cases. The character of the country, the permanency which is given to the work in its first con-

struction, and the amount of business, governs this question to a great extent.

The Erie canal was commenced in 1817, and completed in 1825. Every part of it has been in use 10 years, and some parts of it 15 years. In this period many of the structures of wood have been twice renewed, and all of them once. Several important improvements have been made, such as the widening of aqueducts, &c.; and the banks on much the largest portion of the line have been faced with stone and timber. The great facilities which are furnished to accommodate the large trade which is done upon it, by removing bars and deposits in the bottom of the canal, guarding against breaches, their prompt reparation when they occur, graveling the towing path, attendance at the locks, &c., &c., exceed the expenses which ordinarily occur on canals, and is much greater than would be necessary where a limited amount of business is done.

A statement of the average annual expenses for superintendence and repairs, from 1828 to 1835, will furnish the most accurate information which can be given in regard to this expense.

The annual expense of repairing railroads has not yet been developed by experience.

The Manchester and Liverpool railroad was completed in 1830. The Baltimore and Ohio railroad in 1831; and the Delaware and Hudson railroad in 1829. These companies have severally given a particular statement of the actual annual cost for superintendence and repairs. But this expense will fall short of a true average after the lapse of time within which the wood work of these roads must be renewed.

The proprietors of these roads have furnished a detailed statement of the actual cost of transportation, independent of tolls or profit to the company; which, compared with the actual cost of transportation on the Erie canal, will furnish the best data which can now be given, of the relative expense of transportation on canals and railroads.

The Commissioners have not had it in their power, since the receipt of the resolution, to which they are now replying, to investigate this subject with that care and attention which its importance demanded. One of the acting Commissioners is absent, on account of severe indisposition in his family, and another has been in feeble health. Under these circumstances, and with a view of giving the subject a speedy and careful examination,

they called to their aid John B. Jervis, Holmes Hutchinson, and Frederick C. Mills, Esqs., civil engineers, of experience in the construction of canals and railroads. Their report, accompanied by several interesting tables, is herewith submitted.

The Commissioners have examined this report, and believe the general results to be correctly stated. This report contains all the information which can now be given in answer to the several inquiries submitted to their consideration.

WM. C. BOUCK,
MICHAEL HOFFMAN.

March 17th, 1835.

Report of John B. Jervis, Holmes Hutchinson and Frederick C. Mills.

To the honorable the Canal Commissioners of the State of New York:

GENTLEMEN—

We have examined the question you submitted to our consideration, in relation to the relative cost of construction and repairs of canals and railroads, and also the relative expense of transportation, and present in the following report, the facts and views we have been able to obtain. The importance of the subject compels us to regret that more time could not consistently have been taken to obtain further facts, and allowed us to carry the investigation into greater detail. We have felt compelled, in a great degree, to confine ourselves to an exposition of prominent features in the two methods of facilitating internal communication. We believe, however, the facts presented, and the exposition of the bearing of those facts, will be found useful in leading to correct conclusions in regard to the question under consideration.

RAILROADS.

The utility of railroads is materially, and in some respects, peculiarly affected by the ascent and descent that is overcome, and the relative amount of trade requiring transport in opposite directions. For instance, a railroad requiring transport only in one direction, would be most favorable with such a declivity in the direction of the freight, as would require the same power to move the loaded wagons, as would be necessary to return with

the empty ones; and this declivity would decrease in cases requiring transport in both directions, and become level when the freight was equal.

In this country it rarely occurs that freight is equal in both directions; more frequently it is 2, 3 and 4 to 1. To obtain the most favorable graduation to the trade to be accommodated, it is essential that it be uniform, or nearly so; which the route would not often admit without too great expense, and in some cases would be impracticable. On important lines for general trade that have any considerable extent there will, from the character of the country, often require a level, and sometimes a small ascent, in the direction of the greatest trade; and it would be a favorable compromise to exchange all acclivities and declivities for a level road. Though there would be exceptions, still it is believed a level road would afford a fair standard in determining the general question of utility.

Below will be found a statement of the cost of several rail roads, and in some cases the cost of transportation.

It is to be regretted that more authentic information of a practical character is not in our possession. The authorities, as well as the facts, are stated, to show the weight they are entitled to. In some important cases they are authentic, and these will be adopted as the basis of our conclusions.

Baltimore and Ohio Railroad.

From Baltimore to Point of Rocks, 67½ miles, by report of chief engineer, (October, 1832,) this section was stated to be nearly complete, and the cost $29,193 per mile. In a document of second session 22d Congress, No. 93, it is asserted this road had then cost nearly $34,000 per mile. We have examined the subsequent reports of the directors and their officers, and find nothing to change the statement of $29,193 per mile.

The grading of this road is done in a substantial and durable manner; over $\frac{2}{3}$ of the superstructure is timber sills and rails, capped with an iron plate, $\frac{1}{4}$ (or $\frac{26}{100}$) is stone rails, capped with iron plates, and $\frac{1}{17}$ is timber rails on light stone blocks.

The cost of transportation for the year ending 31st September, 1834, as per report of superintendent of transportation, was for motive power and all other charges, (excluding repairs of road,) except interest and fund for renewal of wagons....... $62,348 57

Superintendent of machinery reports 1,000 wagons on the road; their cost is not given. They proba-

bly cost from $150 to $200 each; if on steel springs, the latter, otherwise the former; they may be estimated at $150 each, which for 1,000, is $150,000; interest on their cost, and to provide a fund for renewal, is believed should be at 25 per cent., which is $37,500 00

Total cost of transportation, exclusive of tolls or profit, for 56,120 tons, is 99,848 57

The average charge of the company, per said report, is within a small fraction $4\frac{2}{3}$ cents per ton per mile, produces the sum of 116,254 79

The ratio of receipts to expenditures is 1 to 0.85, and $4.66 \times 0.85 = 3.96$ cents per ton per mile, as the expenses.

The expenses the previous year are stated by same report to have been higher; but as we have not the detailed statement, we cannot give the exact difference.

This railroad has ascents, descents, and curves, which affect the economy of transportation.

In regard to curves, this road may be considered as having more than is usual on railroads, designed mainly for general trade.

All lines of railroad, of any considerable extent, will be curved more or less, according to the character of the country through which they are constructed. It is the first object to have it straight, and next, the lightest curvature the country will admit. The minimum will, therefore, be determined by local circumstances. While it is considered this road has more curvature than will occur as a general average, it is obviously impracticable to determine what this average may be. The chief engineer J. Knight, of this (Bal. and Ohio) railroad, made experiments on the increased resistance produced by curves, which led him to the conclusion that in a curve having a radius of 400 feet, the traction was increased 50 per cent. If locomotive engines were used, then loads would be regulated by the greatest resistance they had to overcome, on any part of the route; but a horse can increase his effort, for a short distance, which enables him on a road that has occasionally sharp curves or ascents for moderate distances, to perform a greater average of useful effect than can be obtained from locomotive steam power. The freight business for this road is performed by horse power. The sharpest curves generally occur in short distances, intervening between straight

lines and larger curves, and will not, therefore, affect the cost of transportation to so great a degree as if locomotive steam power was used. If we assume ten per cent. of the resistance on a level and straight line, as the excess over a general average arising from extra curvature on this road, and apply it to the section between Parr Ridge and Baltimore, we shall not probably be far from its true influence on the cost of transportation.

The next and most important question that affects the cost of this transportation is, the ascent and descent. The character of this road in relation to its elevations, seems to indicate the propriety of dividing it into sections, and applying on each the power necessary without regard to the other. The following divisions have therefore been made, to wit:

1st. From Baltimore to Parr Ridge, foot of 1st inclined plane—length, $40\frac{1}{4}$ miles; ascent westward, 590 feet; descent, 23 feet; total, 613 feet; ascent averages 14.75 feet per mile.

2d. Embraces the four inclined planes that pass Parr Ridge, 1.94 miles; ascent and descent, 429 feet, viz:

No. 1, 2,150 feet, rise	$\frac{1}{26.75}$	= 80 feet,	Total ascent	179 feet.
2, 3,000 do	$\frac{1}{30.12}$	= 99 do		
3, 3,200 feet, fall	$\frac{1}{20.05}$	= 160 do	do dec't	241 do
4, 1,900 do	$\frac{1}{23.35}$	= 81 do		
Total,				420 do

Intermediate level about $3\frac{1}{2}$ miles.

3d. From foot of plain No. 4, to end of continuous declivity westward, $11\frac{1}{4}$ miles; total descent, 285 feet; average, say 25 feet per mile.

4th. The remainder of road, to Point of Rocks and branch to Frederick, a fraction over 16 miles; descent westward, 169 feet; average 10.56 feet per mile; ascent westward, 131 feet.

Total rise and fall, 300 feet.

The ascent westward, for the four divisions is,	900	feet.
The descent do do	718	do
Total ascent and descent,	1,618	do

By the report referred to, it appears the ratio of freight moving eastward to that moving westward, was nearly as 2 to 1; for calculation we therefore adopt this ratio.

It has been shown that the first division has an average ascent of 14.75 feet per mile. This ascent, however, is not uni-

form; in several places, for short distances, it descends westward, some portions are level, and the ascents are at rates varying between 2.64 and 37.48 feet per mile, excepting a short piece near the foot of inclined plane. They seldom much exceed 20 feet, except for short distances. The length of grades at the higher rates of ascent is generally less than one mile, and alternate with those of medium rate; except near the inclined plane. In view of the character of this division, it is believed animal power will allow such variation, as to accommodate the varying resistance with nearly as much economy as on a uniform ascent. If we calculate on a uniform ascent of 18 feet per mile, we shall not probably vary essentially from the true economy of the case.

It has been observed the freight is as two to one in the opposite direction, being least westward. The weight of the wagons will probably be one third of the gross load; and for computation, we may assume the wagon to weigh one ton; and consequently the freight eastward will be 2 tons, and that westward 1 ton.

The resistance from friction is taken at $\frac{1}{250}$ of the gross load, the velocity being low. On a level this will require nearly nine pounds per ton, on an ascent of eighteen feet per mile, gravity will be $\frac{1}{293}$ of the load, or 7.64 pounds per ton. The wagon and its freight going westward, makes a gross load of two tons; the resistance will therefore be $9+7.64\times2=33.28$ lbs. To carry on a level road a load which, including wagons, would be three tons, the resistance would be $9\times3=27$ lbs. The road, with a few exceptions, descends eastward or is level. The ascents are small and so near the eastern termination, that, in the average, less power would be required than on a level; but we require 33.28 lbs. to move westward, after providing for varied effort by the animal. Now, as a general result, we could not expect a more equal ratio of freight in the two opposite directions, than in this case, and if 27 lbs. is required on a level, we have an excess of power to provide for the load moving westward, of $33.28-27=6.28$ lbs., and as this will return with the opposite load, we have extra power for the two directions $=12.56$ lbs. more than required for a level road, or 23 per cent. extra. This, added to the extra curvature of 10 per cent. raises the extra traction to 32 per cent on this section. The cost of the moving power is nearly two-fifths of the total expense, and $32\times.40=14.80$, say 15 per cent., the cost of transportation over a level road; and $40.25\times.15=6.03$, or equal an increase in the length of this division of six miles.

2d division. The total ascent westward is on the inclined planes Nos. 1 and 2; their total length is 5,150 feet, and ascend at an average rate of one in twenty-eight and three-fourths. It is obvious, the load moving westward will determine the expense of power, as that in the opposite direction on these planes will descend by its own gravity, requiring only the expense of brakemen to control its descent within a safe velocity, which may be done by a part of the drivers, whose teams could be led back by others. In moving up this ascent, a horse would require 35 per cent. of his power to overcome the gravitating force of his body; but as he would be loaded only in one direction, and the length of either plane but little exceeding half a mile, it is believed to be a fair estimate to compute in this case, the useful effort of his power, as equal what it would be on a level. We have one ton of goods and one ton of wagon, making a gross load of two tons moving westward. The total resistance up the plane will be 173 lbs., or 5.4 times greater than the load in the opposite direction, (3 tons gross,) would be on a level. The two planes are together 0.97 miles in length. The ascent will make the extra resistance equal $5.23 \times .4 = 2.09$ miles.

The 3d and 4th planes descend westward; their total length is 5,100 feet, and descend at an average rate of $\frac{1}{21.15}$. For these planes, we must compute the power required to ascend them with the load moving eastward, which is 3 tons, including wagon. The horse will require 47 per cent. of his power to overcome the gravitating force of his body up the plane; and though he will, as in the case of the other planes, be loaded only in one direction, still it is believed that 10 per cent. should be taken from his average useful effect in ascending Nos. 3 and 4. The resistance of 3 tons up these planes will be 344 lbs., equal 11.73 times greater than on a level, or including the loss in the effective power of the horse, equal 13.13 times greater. The two planes are .96 miles $\times 13.13 \times .4 = 4\frac{3}{4}$ miles extra length of transportation. The influence of the planes on this division increases the moving power equal to what would be required for 17 miles of level road, and taking the moving power at 40 per cent. of the total expense of freight, a fraction over $6\frac{3}{4}$ miles, entire cost of transportation.

3d division—Ascends eastward at the average rate of 25 feet per mile, varying from 9.76 to 52.80. The grades that have the higher rates of ascent are short, and in view of the small amount of labor required of the horses in the opposite direction, it will

probably not vary materially from the truth, to compute the power at the average rate of ascent, or $\frac{1}{211}$. A load eastward is 3 tons, including wagons, and the resistance will be 58 lbs., equal 2.14 times that on a level; or for 11.25 miles, requiring extra moving power, equal what would be required for 12.82 miles on a level, or equal the total expense of transportation for $5\frac{1}{8}$ miles.

4th division—Is quite of an undulating character; the ascent is greatest in the aggregate in the direction of the greatest trade, but the grades have a less rate of ascent than in the opposite direction. The average ascent in the direction of the greatest trade, will be a fair basis of computation for the section. This is $\frac{1}{500}$, and the resistance for 3 tons, (as before,) is 40.44 lbs., or 50 per cent. greater than a level. For 16 miles the extra moving power is equal 8 miles on a level, or equal the total cost of transportation for $3\frac{1}{4}$ miles nearly.

In the first division we have extra	equal	....	6 miles.
second, do	do	....	$6\frac{3}{4}$ do
third, do	do	....	$5\frac{1}{8}$ do
fourth, do	do	....	$3\frac{1}{4}$ do
			$21\frac{1}{8}$ do
Total length of road is		....	71 do
			92.12

The actual cost of transportation has been shown to be 3.96 cents per ton per mile. To reduce this to our standard, we have the cost of transportation, exclusive of toll or profits, 3.05 cents per ton per mile, with freight as two to one in the different directions.

By report of superintendent, the moving power cost 1.08 cents per ton per mile.

Repairs.

Year ending October, 1833, $444 per mile.
1834, $321 do

Average for 2 years, $382.50.

A road constructed mostly of timber will vary much in the cost of repairs for different years, and several are therefore necessary to obtain a proper average.

Cost of transporting passengers per mile, 1.98 cents, as stated in Hazard's Register of Pennsylvania, v. 15, p. 112.

Liverpool and Manchester Railway.

In a statement published by Mr. Booth, the treasurer of the company, dated June 30, 1830, the expenditure up to that time,

including an estimate, (the road was at this time nearly com pleted,) to finish some unimportant items of work, it appears the construction of the railway, exclusive of warehouses, wharfs, offices, engines, wagons, and other items not connected with the construction of the road, cost £694,595 for 31 miles, equal £22,406×4.80=$100,748 per mile. There have, subsequently, been heavy expenditures not embraced in the account of repairs, but we are not sufficiently advised of their object to say whether or not any part of it belonged to the amount of the original construction of the road.

Repairs.

It appears from four semi-annual reports of the directors, the expense of repairs has been as follows, to wit:

Report of July, 1832, 1st January to 30th June,...	£7,331	0	6
" January, 1833, 1st June to 31st Dec....	6,878	4	3
" July, 1833, 1st January to 30th June...	6,714	9	3
" January, 1834, 1st July to 31st Dec....	6,425	14	8
Total for two years.......................	£27,349	8	8

Equal, for 31 miles, 882×4.80=$4,233 per mile, which, for one year, is equal $2,116 per mile, commencing about a year after the road was opened for business.

A table is given of the general expenses in the six months previous to that reported in July, 1832, in which the expenses of repairs is included with some other items. This aggregate sum is very nearly the same as reported in detail, showing there had been no material variation in repairs for the six months previous to that particularly reported.

Transportation.

The reports above referred to, embrace four semi-annual accounts for transportation, and one tabular view of transportation for six months previous, from which the following table is made.

The report of July, 1832, contains a statement of transportation for the two semi-annual terms preceding.

In the tabular account given by the directors, the maintenance of way and rate, taxes and omnibusses are charged to transportation; but in the following table these are not included, as it is the design to exhibit the cost of transportation separate from other expenses; these items are given in the table of directors' reports, with others, but are separate in the general account.

TABLE *showing the cost of transportation per passage, and per ton of merchandise, for 31 miles, on the Liverpool and Manchester Railroad.*

	Report of January, 1832.				Report of July, 1832.				Report of January, 1833.				Report of July, 1833.				Report of January, 1834.				Average of five semi-annual statements.			
	Cost per passenger.		Cost per ton of merchandise.		Per Passenger.		Per ton of merchandise.		Per passenger.		Per ton of merchandise.		Per Passenger.		Per ton of merchandise.		Per passenger.		Per ton of merchandise.		Per passenger.		Per ton of merchandise.	
	s.	d.	s.	d.	s.	d.	s.	d.	s.	d.	s.	d.	s.	d.	s.	d.	s.	d.	s.	d.	s.	d.	s.	d.
Disbursements in the merchandise department, consisting of porterage, salaries, carting, stationary engine, disbursements, &c. &c.	....		4	6¾	....		4	0	....		3	5	....		3	7½	....		3	9¾	....		3	10½
Disbursements in the coaching department, comprising porterage, salaries, repairs, &c. &c.	0	7	....		0	7¾	....		0	6¾	....		0	9¼	....		0	9	....		0	7¾	....	
Locomotive power account, proportioned according to the number of trips of 30 miles in each department; comprising repairs of engine, wages, coke, &c. &c.	0	6¼	1	11	0	7½	1	7¼	0	10¾	1	2¼	1	0	1	6¾	0	8¾	1	6½	0	9	1	4¾
Sundry disbursements, proportioned according to receipts, as between coachery and merchandise, comprising police and gate establishment, and general office	0	1⅞	0	3¾	0	2	0	4	0	1¾	0	3¼	0	2	0	3½	0	2⅛	0	2⅝	0	2	0	3⅜
Interest, on loans and chief rents, proportioned according to the amount of profit in each department, calculated exclusively of these items of disbursement	0	4¾	0	4¾	0	6¼	0	8¼	0	4½	0	7	0	5	0	6¾	0	4¼	0	4⅞	0	5	0	6⅜
Total	1	7⅞	7	2¼	1	11½	6	7½	1	11¾	5	5½	2	4¼	6	0½	2	0⅛	5	11¾	1	11¾	6	1

From the reports of the directors and their statement of general accounts, it appears probable, the amount of repairs of wagons and coaches, includes the purchase of new ones when required, to supply the place of those that fail; the interest account is supposed to be interest on cost of locomotives, engines, coaches, wagons, &c.; there is no other item that embraces the interest on the outlay, and it is presumed this is intended. There is a charge for carting included with other items, and from the general account would appear to be about 6d per ton; we have not deducted this item, for the reason it was impracticable to determine exactly what it amounted to; and the question whether the interest account included the total interest on the outlay for the transportation department, with such allowance as would, beyond what was included in repairs, make the necessary renewals, being doubtful, we have thought a further reason for leaving it as it is. The table cannot, however, be far from the proper expense of transportation.

For Merchandise.

The lowest cost per ton is 5s. 5d.=$1.31, or per mile,--4.22 cts.
The highest cost per ton is 7s. 2¼d.=$1.72, or per mile,-5.55 "
The medium, or average of the table is 6s. 1d.=$1.46,
or per mile,------------------------------------ 4.70 "

For each Passenger.

The lowest cost is	1s. 7⅞d.,	equal to	$0.39¾,	or per mile,		1.28 cts.
The highest "	1s. 4¼d.,	"	0.56½,	"	"	1.82 "
The average "	1s. 11¾ d.,	"	0.47½,	"	"	1.53 "

The table below contains the aggregates for one term of six months later than the above table; it does not appear that transportation was lower for this term than previously, but on the contrary is confirmatory of the above average results; which may therefore, be viewed as based on three years' experience.

TABLE *showing the number of passengers, and tons of merchandise, passing the whole length of the road; and also receipts and expenditures for the entire transportation, including the way and coal business, and that passing the whole length of the Liverpool and Manchester road.*

Information, where obtained.	Passengers.			Merchandise.			Total.		Excess of receipts over expenses.	Ratio of receipts to expenditure.
	No.	Expense.	Receipts.	Passing through.	Expenses.	Receipts.	Expenses.	Receipts.		
		£.	£.	*Tons.*	£.	£.	£.	£.	£.	
Semi-annual report of directors, dated July, 1831, for 6 months, ending Dec. 31, 1831...	....	25,930	58,348	....	21,841	29,022	49,025	89,809	40,784	as 1.83 to 1
Semi-annual report of directors, for 6 months, ending 30th June, 1832..................	174,122	21,957	40,044	57,174	22,445	30,436	46,658	74,706	28,048	1.60 1
Semi-annual report of directors, dated January, 1833, for 6 months, ending 31st December, 1832............................	182,823	23,744	43,120	61,995	22,277	35,509	48,278	80,902	32,624	1.67 1
Semi-annual report of directors, dated July, 1833, for 6 months, ending 30th June, 1833.	171,421	24,746	44,130	68,284	26,447	38,149	52,900	86,071	33,171	1.62 1
Semi-annual report of directors, dated January, 1834, for 6 months, ending 30th December, 1833............................	215,071	27,345	54,685	69,806	27,357	38,641	56,350	97,234	40,884	1.70 1
Railroad Journal, vol. 3, 609, given as facts from report of directory of July, 1834, for 6 months, ending June 30th, 1834..........	244,326	....	50,770	77,528	....	44,014	60,092	94,784	34,692	1.57 1

NOTE.—It will be perceived the column of tons only embraces that passing the whole length of the road, while the receipts and expenses on transportation include the way business.

Having ascertained the cost of transportation on the Liverpool and Manchester railway, we now proceed to reduce the cost of freight to our standard of comparison; a level road.

Inclined plane at Liverpool.

Length, 1.12 miles; rise $\frac{1}{48}$. The extra cost of the transit for moving power, taking the average from two semi-annual reports, is 1.80 cts. per mile, 2.02 cts. for the total length, per ton; equal, for total cost of transportation, to 0.43 of a mile, on a level.

Sutton and Whiston planes,

Are each $1\frac{1}{2}$ miles long, and have an inclination of $\frac{1}{96}$ or 55 feet per mile. They incline in opposite directions, and therefore, if the trade was equal in each direction, only one plane should be calculated as affecting the total transportation; as it is obvious, a load passing in either direction, would only require additional power to ascend one plane. In the reports of the directors they give the total freight, not distinguishing between the different directions; and we are left to determine, from the general character of the trade, whether any and what difference there was. It appears that not more than $\frac{1}{6}$ of the tonnage between the two cities passes on the railway; and we, therefore, are led to infer the railway takes the lighter character of freight, which is, probably, about equal in both directions; and our computation of cost is made on this basis.

This road being worked entirely by locomotive steam power, except the inclined plane at Liverpool, which has stationary power, our computation is made accordingly.

In ascending the plane the resistance will be $\frac{1}{225}$, (friction,)+$\frac{1}{96}$,(gravity)=$\frac{1}{67}$, or ratio to a level of (3.35 to 1,) or a little more than three and one-third to one. The power of the engine will be reduced by its gravity, and that of its tender to 70 per cent. of its power, on a level; or to make it equal its power on a level, it must be increased to 142 per cent., which makes the cost of moving power to ascend the plane, as compared with a level, as 4.75 to 1, or four and three-fourths to one. The extra moving power to ascend this plane over a level, is equal to the transit of 5.62 miles on a level. The moving power is 26 per cent. of the total transportation, exclusive of the interest account in which the items of moving power and wagons are blended; this will not be less than 4 per cent., making the total cost of moving

power at least 30 per cent. The extra cost of the planes are, therefore, equal 1.68 miles entire transportation on a level.

The greatest inclination on any part of this railway, except the inclined planes above mentioned, is $\frac{1}{880}$ or 6 feet per mile. It is presumed the ascent of this inclination will regulate the load of the engines, on which the resistance will be $\frac{1}{225}+\frac{1}{880}=\frac{1}{179}$, or ratio to a level of 1.25 to 1. The power of the engine will be reduced by its gravity, and that of its tender to 97 per cent., or its power must be increased over what would be required on a level, say to 104 per cent., making the cost as compared with a level, as 1.30 to 1. This will be applicable to 27 miles of road, on which the extra cost for moving power is equal 8.1 miles, or for entire transportation equal 2.43 miles.

The influence of the elevations on this railway in increasing the cost of transportation over that of a level, is (43+1.68+2.43=4.54,) a little more than four and half miles of level way. The actual average cost of transportation for 31 miles was found to be (4.7,) nearly four and three-fourths cents per ton, which, reduced to a level road, we find to be (4.07,) over four cents, per ton, per mile.

An interesting fact is developed in this investigation, in relation to the comparative cost of transportion on inclined planes by stationary and by locomotive steam engines. The plane at Liverpool is worked by stationary steam power, and has an inclination of $\frac{1}{48}$ or 110 feet to the mile. The Whiston and Sutton planes, worked by locomotive steam power, have an inclination of $\frac{1}{96}$ or 55 feet in a mile, being exactly half the inclination of the Liverpool; yet the cost of moving power on the Liverpool to Whiston or Sutton is as 1 to 2.90; showing that locomotive power, for an ascent of 55 feet to the mile, is about 3 times the expense of stationary power for a plane 110 feet to the mile, calculated for equal horizontal distances. It should be observed, in relation to this fact, that economy of stationary power on inclined planes, depends materially on the amount of business. In this case it was about 500 tons per day.

Baltimore and Washington Railroad.

This road commences at a point in the Baltimore and Ohio railroad, about 6 miles from Baltimore, and extends 30 miles to the city of Washington. Its operations are conducted by the Baltimore and Ohio company. In their report of October, 1833,

they state the estimated cost at a little over $53,000 per mile, for 26 miles. The estimate for the whole 30 miles is given at $50,000 per mile, in a report on canals and railroads, as presented 25th June, 1834, to the House of Representatives in Congress. In their report of October, 1834, the directors say the graduation and masonry (the part of the expenditures liable to the principal contingencies) is nearly completed; they make no allusion to the probability of the work costing more or less than the estimate; and as it would be natural to do so, if any important disagreement was probable, it is inferred the road would cost the estimated sum; and being so near completed we have thought it proper to put it in the table. This road has iron rails on stone foundation, except the embankments, which have timber foundation.

Columbia Railroad.

This railroad is 82 miles long, and per last report of Pennsylvania commissioners, the road has cost, including an estimate for an unimportant amount of unfinished work, $40,450 per mile. It has mostly iron rails, partly on stone and partly on timber foundation.

Allegany Portage Railroad.

This railroad is 36 miles long, and per report of Pennsylvania commissioners, has cost, including a small estimate for unfinished work, $47,977 per mile. It has iron rails for a fraction over two-thirds its length, about half of which are on a stone foundation, and the balance on timber; nearly one-third is timber road with iron plates.

Mohawk and Hudson Railroad.

The main stem of this road is 16 miles in length. It has timber rails with iron plates, about half of which are on a stone foundation, and the other half on timber. Cost per mile of double road, $38,107, per company books. (They have also about 3½ miles of single road in branches, that cost $15.847 per mile.)

Actual cost of transportation for freight by locomotive and stationary steam, 3.5 cents per ton per mile. All the ascent for the greatest trade, (being as 3 to 1,) is overcome by one stationary engine, which does not materially enhance the ratio of cost over a level, taking the whole road. Experience has been quite limited on this road, and considering that the ratio of trade in

different directions, in connection with the facility of overcoming the principal elevation by stationary power, would not materially increase the cost of transportation over a level, it has not been thought important to reduce it by computation. The cost of transporting passengers has been 1.7 cents per mile.

Saratoga and Schenectady Railroad.

This railroad is 22 miles long. It is constructed with a timber rail, capped with an iron plate on timber foundation, except about three miles that has a light stone foundation. This road has a single track; it cost, per report of directors, November, 1832, $11,010 per mile, exclusive of building, &c.; to make a second track of the same character, would cost $6,000, making the total cost for double road $17,010 per mile.

Delaware and Hudson Canal Company Railroad,

Is 16 miles long, has 5 miles of double and 11 miles of single track. The valleys on this road were generally bridged with timber. The road is timber with an iron plate. It cost originally, including stationary engines, about $10,500 per mile, (the exact amount not known.) To have made it double would have raised the expense to $14,000 per mile; average annual repairs for four years is $623 per mile. Transportation when the business is at 250 tons per day, is 4 cents per ton per mile, and when 500 tons per day, is 3 cents per ton per mile. This arises mostly from the cost of operating the planes, which is nearly the same in both cases.

The ascent of this road (855 feet) is overcome by five stationary steam engines, working on planes whose total length is 2½ miles. The cost of motive power for 500 tons per day, averages essentially the same as it does for horse power on a level, having the same in horizontal length. From the summit the principal descent is effected by three self-acting engines, so arranged that the loaded wagons draw up the empty ones; and the balance of the declivity is advantageously arranged for a descending trade. The economy in the use of stationary steam power, arising from the cheapness of fuel and the great regularity which may be obtained in a coal business, and the comparatively small amount of agencies to conduct the business, leave no doubt on our minds that transportation is effected on this road as cheap per ton per mile as a general business could be on a level road.

Newcastle and Frenchtown Railroad,

Is 16 miles long; timber rail capped with iron plate, about

one-third on light stone foundation and the remainder on timber; cost $30,000 per mile, (see report of committee on roads and canals to Congress, January 25th, 1834.)

Camden and Amboy Railroad.

The part extending from Amboy to Bordentown is 33 miles in length; is believed to be entire iron rail, partly on stone and partly on timber foundation; cost (as per Congressional report above mentioned,) $30,000 per mile.

South Carolina Railroad,

Is 130 miles long; timber rail capped with an iron plate. This road is built on piles; no embankments made in the grading; cost about $7,000 per mile. It is not known whether it is a single or a double road, but believed to be mostly single track.

There are several important railroads in the United States, which we should have been gratified to have added to those above given; but we have not the information in relation to them that would enable us to derive any practical advantage. There are others that we have not thought proper to introduce in a question that relates to the general utility of railroads as public thoroughfares; they are roads made mostly for local objects, or for short distances, where the surface of the ground is nearly level, and the road made to conform nearly to the natural level or inclination, and very little expense incurred to remove those irregularities in the surface, which in a road of any considerable length and importance are generally encountered, to obtain an economical grade; and the superstructure of such roads are usually made in an imperfect manner, not calculated to serve the purpose of accommodating an important general trade.

In the roads described it is believed a fair view may be obtained of the general question of cost. In their *graduation* some have been of an expensive character, to wit: The Baltimore and Washington, Allegany Portage, the Columbia, Mohawk and Hudson, and part of the Baltimore and Ohio, though on the average the latter cannot be much above a medium; the Camden and Amboy, and the Newcastle and Frenchtown rather below a medium, and the Saratoga as very favorable. The South Carolina road having been placed on piles, excavation has been avoided as much as possible, and embankments omitted altogether, by which the expense of grading has been very little. The general cha-

racter of the superstructure has been stated; and their rails, or the foundation of the rails, appears to be to a greater extent of timber.

The superstruction of railroads when composed of timber with the rail capped with an iron plate will cost, for a double track, from $6,000 to $10,000 per mile, according to the value of timber and the stability given to the road; (this is exclusive of grading.) The cost on the Baltimore and Ohio, for this kind of road, was $8,852 per mile. When composed of iron rails, laid on stone foundations, the cost will vary from $18,000 to $25,000, according to the convenience in obtaining stone, the extent of the ballasting, and the weight of rail that may be adopted; the probable average may be $22,000 per mile. The difference then, between a medium of the two kinds, is $14,000 per mile. To have adopted the iron rail on a stone foundation in the roads mentioned, would have materially increased their average cost. But in the first construction, it is usual, even when iron rails are adopted, to put down a timber foundation to support them on the embankments, until the embankments have time to become fully settled.

The first railways in England, were constructed of timber without any iron. The timber being found to wear too rapidly under the wheel, the iron plate was then put on. From this rude beginning in railroads, their advantages began to be developed; and experience soon suggested improvements. Hence we find the wooden rail soon abandoned, even in the coal districts. Cast iron rails on a stone foundation followed timber; and now wrought iron is generally used in preference to cast iron. These remarks are introduced to show the result of experience in England. In this country, timber will doubtless be used to a greater extent, and for a longer period, than it was in England. The cheapness of timber, the want of capital, and the limited amount of business in many places, will operate as causes to produce this result. We already observe, however, in this country, a departure from the use of timber rails on several important railroads. Among those who have critically attended to this subject, there is probably very little difference of opinion, in regard to the most suitable material for rails and their foundation, when an extensive business may be anticipated, and particularly where a high velocity is an object. The Baltimore and Ohio railroad company, after an experience of several years with timber rails, have come to the following conclusion, as appears in their last

annual report: "In the construction of the Washington road, the board have had regard to its durability, not less than to making it a source of immediate profit to those interested in the undertaking. The experience of the main stem, has *conclusively* shown, how important it is, to avoid the expense of repairs of the railway, which not only materially affect the revenue, but occasion constant *interruption* and *inconvenience* to the *travel* on the road. True economy consists in constructing the road, in the first instance, so as to obviate the necessity of *frequent* repairs, and to enable the *motive power* used in transportation, to be employed to its fullest effect, without the *fear* of injury to the rails or bridges over which it passes in the performance of its daily work."

Timber is found to be less durable in a railroad than in almost any other situation. The action of the carriages tends to open the pores of the timber, which renders them more liable to imbibe moisture; all horizontal joints are much exposed under this action, and particularly that under the rail plate. There is, no doubt, situations where timber may be advantageously adopted. The cheapness of this article, the scarcity of stone for foundations, the scarcity of capital, limited extent of business, and the experimental character of the particular investment, will often present arguments in favor of its adoption. At the same time, we are fully of the opinion, that all railroads, which constitute important avenues of communication, the period is not distant when timber rails will be wholly abandoned for iron.

The question in relation to the average cost of railroads, it will be difficult to determine, as the graduation will be very different at different places. The table given, of the cost of several railroads, excluding the Liverpool and Manchester, would afford an average of $30,393 per mile. Had all these roads been constructed entirely with iron rails and stone foundations, their average cost would probably have been between $35,000 and $40,000 per mile. Taking all the railroads, designed to accommodate a large general trade, that have been constructed in this country, and add to their expense what would be required to complete an iron rail with stone foundations, we believe the cost for a double road would not fall below $35,000 per mile; and to reduce the same to a timber road of the best character, would not be less than $25,000 per mile. The grading in both cases, is supposed to be done in a permanent manner. We are aware of the fact, that railroads, in some instances, have been made for

much less; but for the reasons before given, we do not believe them entitled to a place in this examination, which is designed to investigate the utility of railroads as a means of general intercommunication of trade. There is no doubt, many situations where the favorable formation of the country, and the facilities for obtaining materials, will reduce the cost below the amount stated above, and a less expensive road may be sufficient for the trade to be accommodated. But there will be others that will be more expensive, as experiences has fully demonstrated; and our object is to reach an average result for the accommodation of a general trade, where expedition, regularity and economy in the moving power will be important. It should be observed in relation to this question, that the cost of a railroad will depend materially on the amount of tonnage, and the speed it is necessary to maintain. This arises from the economy of motive power; for instance, where a small amount of business is to be accommodated, it will be economy to apply greater motive power, and avoid expensive graduation; on the other hand a large amount of trade, will induce a greater expense in bringing the lines of graduation to the most favorable standard for economizing this power.

Remarks in relation to repairs on Railroads.

Experience on this point is yet quite limited. We have the account of two years on the Baltimore and Ohio road, four years on the Delaware and Hudson Company road, and four semi-annual statements of the Liverpool and Manchester road. We have also, in relation to the latter, a general statement of the half year preceding, and the half year subsequent to the four full reports, from which we are led to infer that no material variation occurred for three years. The average of the three roads is $1,040 per mile per annum.

There is a great difference in the annual expense of repairs for these roads, which suggest the propriety of examining into the cause.

The moving power on the Baltimore and Ohio, and also on the Delaware and Hudson Company's road, admitted for freight only a moderate speed, probably seldom exceeding four miles per hour, and nearly the same amount of tonnage was conveyed on each: on the latter, no passengers are carried; on the former, the passengers constitute about half the business.

The Baltimore and Ohio road has less timber in its structure,

though it has a large majority of timber road. The Delaware and Hudson Company road is about two thirds single track, and considering the passenger business, has not over half the use, and still its repairs are more than fifty per cent. higher. Two years, with a moderate amount of trade, on a timber road, would not give a fair average of the cost of repairs, and the condition of the two roads at the end of the year, in regard to the age and durability of their timber, may be very different. We are, therefore, led to conclude that further experience will show the repairs on the Baltimore and Ohio road, as the business increases, to be greater than they have hitherto been.

The Liverpool and Manchester road has cost over five times as much for repairs as Baltimore and Ohio, and over three times as much as the Delaware and Hudson Company road. The Liverpool road was made in the most substantial manner, with very little curvature. The Baltimore road is very much curved, which increases the expense of maintaining the parallelism of the rails. The statement of the cost of repairs and maintenance by the directors of the Liverpool road is very explicit, and continued for successive terms with very little variation, leaving no ground to misunderstand the subject. The amount of business on the Liverpool has been from three to four times as great as on the Baltimore for equal terms of time; and the velocity of traveling, both with freight and passengers, has been also much greater on the former than on the latter. In view of all the facts we have obtained, we are led to the conclusion that the amount of business, and the velocity of traveling, has a material influence on the question of repairs. In the last report, the directors of the Liverpool road, they allude to the expense of maintaining their road on the Whiston and Sutton planes, in consequence of the high velocity which the engines and wagons often obtain in their descent; and propose to lay heavier rails to guard against this inconvenience. In a report recently made to the directors of the London and Birmingham railway, by R. Stephenson, (late engineer of the Liverpool road,) on the propriety of adopting the undulating plan, he urges, as an objection to this plan, the injurious tendency of the high velocities obtained in the descents, to the road, and particularly to the locomotive engine, as a reason that he considers conclusive against it.

The repairs of a railroad composed mostly of timber, will

generally be much less for two or three years after it is put into operation, than the average for a term of ten or fifteen years. Our experience is limited in this branch of the investigation, but from the facts we have obtained, we are led to the conclusion that the average expense of repairs for a road designed to accommodate a large general trade requiring a high velocity, will not be less than that stated as the average of these roads, viz.: $1,040 per mile per annum.

Transportation on Railroads.

The cost of transportation (reduced to a level road) on the Baltimore road, we have found to be 3.05 cents per ton per mile, and 4.07 cents per ton per mile on the Liverpool road. In the former case it is done by horse power, in the latter, by locomotive (except on one plane) steam power. The ratio of cost of motive power to the entire cost of transportation is, for the Baltimore road, as four to ten; and for the Liverpool road as three to ten. It therefore appears that the Liverpool road, with ten per cent. less ratio in cost of motive power, (which makes the motive power more nearly equal on the two roads,) cost one third more for entire expense of transportation. If our accounts can be relied on as presenting accurate results, it would appear highly probable the extra expense in repairs and management of the business, was incurred in consequence of the greater speed maintained. Some abatement should doubtless be made for the ratio of difference in expense of loading and unloading, which, in consequence of its being shorter, would bear heavier on the Liverpool road than on the Baltimore. The accounts for the Liverpool transportation are presented in much detail, and are very satisfactory in their character. Those for the Baltimore road are not given in as much fullness and detail, but we have no reason to doubt their accuracy. It further appears that horse power is a little more expensive for motive power, at a low velocity, than locomotive steam at a high velocity, as compared for the two roads. But this would not be the case if the power was reversed for the two roads, as the short ascents on the Baltimore road would greatly depress the economy of steam power. The average cost of transportation on these two roads, when reduced to a level, is 3.56 cents per ton per mile. This allows no profit or toll; the cost stated for the Mohawk and Hudson road is 3.5, and for the Delaware and Hudson Company's road is also 3.5

cents per ton per mile, as the net cost. It may, therefore, be considered that experience thus far has settled the cost at $3\frac{1}{2}$ cents per ton per mile on a level road.

It has been shown in this investigation, that where locomotive steam power is used, it is important to its economy, to have all the inclination reduced to a uniform angle, and the curves to a uniform radius, otherwise the traction that occurs on the sharpest curves, and greatest ascents, will determine the load of the engine. It is obvious that the load of the engine must be regulated by its ability to overcome the greatest resistance that occurs on the road over which it passes, unless extra power is stationed on the line to aid in passing ascents: the inconvenience of stationary power would prevent a resort to this method, unless the increased power required, was considerably greater than was generally necessary on the route traveled. This consideration is highly important where a large general trade is to be accommodated, and accounts for the great expense that is often encountered to bring the grade to the most favorable standard.

The cost has been shown to be $3\frac{1}{2}$ cents per ton per mile on a level, and as railroads are not often entirely level, it has been thought proper, to a full understanding of the subject, to present a statement, showing the comparative economy in motive power by locomotive steam engines on roads of different inclinations. In the calculations, the engine is assumed to weigh $6\frac{1}{2}$ tons (13,000 lbs.,) with 7,000 lbs. on its working wheels; adhesion at 10; the weight of the tender at 7,000 lbs.; resistance from friction $\frac{1}{225}$. The load carried is exclusive of the tender, and includes freight and wagons. Two-thirds of the gross load will be tonnage goods.

				Tons.
On a level the gross load will be				75.25
On a road or section having an ascent of		10	feet per mile,	49.53
do	do	20	do	37.35
do	do	30	do	27.24
do	do	40	do	20.22
do	do	50	do	17.04
do	do	60	do	13.92
do	do	70	do	11.31

In the load on a level, we have 50 tons exclusive of wagons, taking the cost of motive power at 40 per cent. of the entire cost of transporation; the total cost at the level being $3\frac{5}{10}$ cts.

				Cents.
The total cost on an ascent of	10	feet per mile is per ton,		4.20
do	20		do	4.90
do	30		do	5.95
do	40		do	7.28
do	50		do	8.19
do	60		do	9.66
do	70		do	11.41

There are engines of a larger size than the one assumed; but it is the most approved at this time, in reference to the weight of engine, and the weight of the working wheels. This, however, is unimportant, as the comparison will not be at all affected by varying the power of the engine; the ratio between a level and the ascents will remain the same notwithstanding.

Costs of Canals.

We subjoin a table marked A, containing the cost of 50 canals in England; this table gives the name of each canal, the total cost in pounds sterling, cost per mile, length of each canal in miles, lockage in feet, date of completion, original cost for each share, and the value and dividend of each share in 1821, in March, 1828; in November, 1831; in 1833, and on the 21st of October, 1834. Forty-five of these canals, being the most important in England, have an aggregate length of 1,464 miles. We also, subjoin a table of the principal railways, only one, however, of those which are completed and in operation (the Liverpool and Manchester) is calculated for general trade.

In table B, we give a view of the principal canals in this country; it contains all the particulars that we were able to obtain of 40 canals, principally in the northern and middle States. It has the names of the canals, the length of the main trunk and feeders, depth of water, width of surface, number of locks, their length and width, and the aggregate lockage on the canals and feeders, number of dams, date of completion, cost per mile, total cost and the tolls for each, for the years 1833 and 1834.

The information contained in the tables for the canals of this State, was obtained from public records and from documents in the Comptroller's office. That for the Pennsylvania and the other canals, were taken principally from the official reports, and

from information derived from the officers having charge of these canals respectively; we have also been assisted in the inquiries by private records and memorandums in our possession.

The Erie canal extends from the Hudson river at Albany to Lake Erie; is 363 miles long and has 689 feet of lockage; the canal is 40 feet wide on the surface, 28 feet wide at the bottom, and four feet deep. The locks are 90 feet long, between the gates, 15 feet wide, and built principally of limestone, laid in hydraulic cement, with the front stone cut and laid in courses. Although there is a small amount of elevation, compared with the distance, being but $1\frac{9}{10}$ feet of lockage per mile, there are few places that presented formidable difficulties in the construction; a part of the distance between the Hudson and Schenectady, the rock excavation at Little Falls and the deep cutting in the mountain ridge west of Lockport.

The Champlain canal is the same dimensions as the Erie canal; the locks are constructed in the same manner, except they are 7 feet longer, and one foot less width. This canal is 64 miles long, and extends from the junction 9 miles north of Albany to Lake Champlain. The summit is supplied with water from the Fort Edward pond, and by a navigable feeder from the Hudson river, taken out above Glens Falls.

The Glens Falls feeder is 7 miles long, and, with the pond, makes a navigation of 12 miles in length; there is a descent of 132 feet by 13 wood locks.

The Oswego canal is constructed similar to the Erie canal, but has nearly one-half river navigation. The locks are of the same dimensions and quality, except one, which is built of wood.

This canal extends from the Erie canal at Syracuse to Lake Ontario.

The Cayuga and Seneca canal is, with the Cayuga branch, 23 miles long, connects the Erie canal at Montezuma with Seneca lake at Geneva, one-half of which is river navigation. It has 11 wood locks that overcome an elevation of 80 feet. The dimensions of the canal and locks are similar to those on the Erie canal.

The Crooked Lake canal is 8 miles long, connects the Crooked and Seneca lakes, and has 269 feet of lockage; this, although the locks are of wood, is the most expensive of the State canals; the large expenditure is accounted for by the great elevation overcome, and by the difficulties in construction in the narrow rocky valley of the outlet.

The Chemung canal extends from the head of the Seneca lake to the Chemung river; it is 23 miles long, and the summit is supplied by a feeder of 13½ miles in length, from the Chemung river, at the Chimney Narrows, in Steuben county. This canal and feeder, (as also the Crooked Lake canal,) is 42 feet wide on the surface, 26 feet wide on the bottom, and 4 feet deep; the locks are of wood, connected with the upper level by a wall of masonry at the head. The length of navigation, including 2½ miles of pond in the Chemung river above the feeder dam, is 39 miles, with a lockage of 516 feet, and is the cheapest of the State canals.

The Erie canal cost	$19,255 49	per mile.
Champlain	15,520 95	do
Oswego	14,879 93	do
Cayuga and Seneca	10,295 85	do
Crooked Lake	19,597 11	do
Chemung	8,504 96	do

The aggregate cost of the six State canals, paid by the Canal Commissioners for their construction up to the time when they were completed, for the 558 miles of navigation, is $9,692,106.68, being an average cost of $17,367.57 per mile.

The Delaware and Hudson canal extends from the Hudson river, near Kingston, to Honesdale, on the Lackawaxen river, in the State of Pennsylvania. This canal is 108 miles long, 36 feet wide on the surface of the water, and 4 feet deep. The locks are 76 feet long, nine feet wide in the chamber, 110 in number, and overcome an elevation of 1,073 feet; 60 of the locks are of hammered stone masonry, and 50 are composite, of stone and wood.

There was some formidable rock excavation in the valley of the Delaware and Lackawaxen rivers, which increased the expense of construction. The average cost of this canal was $20,665 per mile.

Pennsylvania Canals.

The Pennsylvania State canals are divided into 9 divisions, and they have an aggregate length of 601½ miles. The main line of these canals form a communication in connection with the Columbia and the Portage railroads, between Philadelphia and Pittsburgh. Between these places there are 282 miles of canals, and 119 miles of railway.

The Delaware division extends from Bristol to Easton, 59¾ miles; and in the valley of the Susquehannah, including the west and north branch, there are 183 miles of canal, besides the Beaver and French creek divisions, west of the mountains. These

State canals have 1,933 feet of lockage, and their total cost is $13,301,235.69, or an average of $22,113.44 per mile.

Beside the State improvements there are three important canals in Pennsylvania owned by corporations, viz: the Schuylkill, the Lehigh, and the Union canals.

The Schuylkill canal extends from the city of Philadelphia up the river of that name, 108 miles, to the coal district. This work has 62 miles of canal, and 46 miles of pools, formed by 28 dams across the Schuylkill river. There are 92 lift and 28 guard locks, and the total lockage is 588 feet. This canal was completed in 1825, and the business upon it has increased so rapidly that it has been necessary, and the directors are now constructing double locks to accommodate the trade. At its completion, (in 1825,) the canal cost $16,741.26 per mile.

The Lehigh canal was constructed principally for the transportation of coal, and extends from Mauch Chunk to Easton, on the Delaware river, 46¾ miles. This canal is 60 feet wide on the surface, and 5 feet deep; the locks are 100 feet long (except 4, which are 130,) and 22 feet wide in the chamber; and its large dimensions has doubtless added much to its cost.

Coal that is brought from the Lehigh mines down this canal, may be sent to Philadelphia by the Delaware canal, or to New York through the Morris or the Delaware and Raritan canals. This canal cost $33,610.75 per mile.

The Union canal connects the Schuylkill and Susquehannah rivers; this, although a small canal, 36 feet wide on the surface of the water, and 4 feet deep, has been expensive in construction. Connected with this canal is a feeder of 24 miles in length, to supply its summit level. This feeder is navigable, and a railroad of 4 miles in length extends to the coal mines. A large expenditure has been incurred to construct reservoirs, 3 feeders, and for the use of two steam engines, of one hundred horse-power each, to supply the summit level with water, and for several miles the sides and bottom of the canal have been planked, to prevent leaks in the limestone districts. This canal cost $18,518.51 per mile.

The three canals have 1,452 ft. of lockage, and cost $5,354,151.13, and the average cost of the 262¾ miles is $20,377.36 per mile.

The State of Ohio completed their canal, from Lake Erie to the Ohio river, in 1832, which, together with the Miami canal and feeders, make an aggregate of 400 miles of navigation. The total amount of lockage is 1,557 feet; the locks, 184 in number,

are constructed of cut stone laid in hydraulic cement; and the total cost of the canals and appendages, as appers in the Canal Commissioners' report of 1833, is $4,189,539.64, or an average of $10,473.84 per mile.

The Chesapeake and Ohio canal will form a communication from the city of Washington, 342 miles in length, to Pittsburgh. That portion nearly completed and navigable extends from Tiber creek, in Washington city, 109 miles, to a point eight miles west of Williamsport. This canal varies from 5 to 7 feet in depth, and from 50 to 80 feet in width; the ascent is 353 feet, overcome by 44 lift locks, 100 feet long by 15 feet wide in the clear, constructed of cut stone masonry laid in hydraulic cement.

This canal is situated in the valley of the Potomac; it is of large dimensions, and formidable difficulties have been encountered in its construction. The amount expended and required to complete 109 miles is $4,164,732.04, or an average cost of $37,291.12 per mile.

There are five canals in New England, having an aggregate of 170½ miles in length, with 1,363$\frac{6}{10}$ feet of lockage, constructed by private corporations, at an expense of $2,187,000, or an average of $12,838.71 per mile. The Blackstone canal, between Worcester and Providence, of 45 miles long, has 48 locks of cut granite, laid in cement; the other four canals have wood locks.

Three of the canals embraced in the tables are of large dimensions, and were constructed of suitable capacity for the navigation of coasting vessels.

These canals connect the great bays of the Atlantic as follows, viz: The Dismal Swamp, between Albemarle sound and the Chesapeake bay; the Delaware and the Chesapeake canal, across the peninsula between those bays; and the Delaware and Raritan forms a channel for coasting vessels between Philadelphia and New York. The above, with a canal between Barnstable and Buzzard's bays, were originally designed as the four great cuts to connect and form a continuous inland coasting navigation from Boston harbor to the bays of North Carolina. One of these canals, the Delaware and Chesapeake, was attended with peculiar difficulties in its construction, but neither are considered as proper for a standard of comparison.

The following table exhibits the length, lockage, and cost of some of the principal canals:

TABLE

Exhibiting the length, lockage, and cost of some of the principal Canals.

	NAMES OF CANALS.	Length.	Lockage.	Cost per mile.	Total cost.
		Miles.	Feet.		
6	New York State canals	558	2,016½	$17,367 57	$9,692,106 68
1	" Delaware and Hudson	108	1,073	20,665 00	2,231,820 00
9	Pennsylvania State canals	601½	1,933	22,113 44	13,301,235 69
3	" Schuylkill, Lehigh and Union	262¾	1,452	20,377 36	5,354,151 13
2	Ohio State canals	400	1,557	10,473 84	4,189,539 64
1	Chesapeake and Ohio canal	109	353	37,291 12	4,164,732 04
5	New England canals	170½	1,363 6/10	12,838 71	2,189,000 00
27	Canals. Totals	2,210	9,748	$18,608 41	$41,122,585 18

By the preceding table it appears that 27 of the principal canals of this country, having an aggregate length of 2,210 miles, with 9,748 feet of lockage, embracing many difficulties, and constructed in nine of the United States, in a great variety of locations, have cost $41,122,585.18, or an average of $18,608.41 per mile.

Repairs of Canals.

It appears from the report of the Comptroller, Assembly Document No. 216, of 1835, that the repairs of the State canals, including salaries of superintendents and lock-tenders, have been for the last year as follows, viz:

For the Erie canal, including 14 miles of the Champlain, and the sloop-lock at Troy,	$883 77	pr mile.
Erie and Champlain canal	1,005 03	"
Oswego canal	320 63	"
Cayuga and Seneca canal	401 46	"

The repairs for the last 3 years, ending September 30, 1834, have been annually,

For the Erie and Champlain canal	$826 13	pr mile.
Oswego canal	313 13	"
Cayuga and Seneca canal	339 88	"

And for the last 6 years, from 1829 to 1834, both years inclusive, ending on the 30th September, the repairs have been, annually,

For the Erie canal	$603 76	pr mile.
Champlain canal	681 01	"
Oswego canal	309 19	"
Cayuga and Seneca canal	301 07	"

In the document before alluded to, there is a division of the cost of repairs upon the Erie canal, stated separately, and the amount for the last year is,

For 159 miles, from Buffalo to Montezuma	$600 47	pr mile.
73 miles, from Montezuma to 7 miles west of Rome	660 34	"
146 miles, from 7 miles west of Rome to Albany, including 14 miles on the Champlain and the Troy dam and lock	1,304 04	"
The repairs of the Erie canal in 1829 averaged	493 12	"
" " " 1834 "	883 78	"

Being an average in the cost of repairs, of 79 per cent.

The lockages at the first lock west of Schenectady—

In 1829 were	12,619
In 1834 were	22,911

An increase of 80 per cent.

The last results, as do also the comparisons of former years, indicate that the expense of the repairs of the Erie canal increases in nearly the same ratio as the business.

The repairs on the Delaware and Hudson canal, for the last 4 years, ending Dec. 31, 1834, was an average of $527 per mile; and for the year 1833, including the salary of superintendents and lock-tenders, on the Schuylkill canal, was $710.44 per mile.

Cost of transportation on Canals.

In this inqniry we have selected three canals that have a large amount of business and those that have their prices well established.

The Erie canal, and the Delaware and Hudson canal in this State, and the Schuylkill in Pennsylvania. We are not able to give the items that compose the cost of freighting upon canals, with the same certainty as that expense has been reported by the Liverpool and Manchester, and the Baltimore and Ohio railroad companies; but we assume the prices, paid on canals for down freight, upon articles of the greatest tonnage.

The Schuylkill canal in 1833, had 361,054 tons of down freight, of which 250,558 was coal from the mines; and the up freight, consisting of merchandise, plaster, iron ore, &c., amounting to 84,795 tons. The price for the transportation of coal, is one cent per ton per mile, exclusive of tolls.

The Delaware and Hudson canal company, in 1833, sent to market from the mines, 111,777 tons of coal, and the merchandise up, amounted to 9,700 tons. In 1834, the coal sent to the Hudson river, was 45,000 tons. The established price of transportation was $1.12½ per ton; of 2,240 pounds of coal for 108 miles by this canal, from Honesdale to the Hudson river, 1.041 cents per ton per mile.

The property arriving at tide water, by the Erie and Champlain canals, in 1834, as appear from official statements,

Was equal to	553,825 tons.
Passing from tide water	114,608 "
Making an aggregate of	668,433 "

The proportion of down freight or property going to market is to merchandise or tonnage going from tide water, as $4\frac{83}{100}$ to 1 or as 5 to 1, nearly.

The cheapest prices of freight on the Erie canal, are paid for staves, timber, wood, stone, lime, plaster and salt; the highest charges are for merchandise. We put down the rates, exclusive of tolls, as charged by the different forwarding lines, although goods are frequently taken up the canal by boats unconnected with the lines, at about half those rates; this higher price is intended, besides the cost of freighting, to pay for the risk to which the forwarding merchant is liable as a common carrier.

During the season of navigation last year, there was brought down the canals, 32,670 tons of staves, and we are informed, that the average price of transportation of this article, has been $2 per ton for the last 6 years, from Tonnawanta to Albany, exclusive of tolls. The distance is 352 miles by the canal, and this would give only $\frac{57}{100}$ of a cent per ton per mile.

There was also sent down—

181,016	tons of boards and scantling,	at $\frac{74}{100}$	of a cent per mile.	
96,642	" of wood	" at $\frac{32}{100}$	"	"
23,894	" salt, to Buffalo passing Utica,	at $\frac{47}{100}$	"	"
70,372	" merchandise,	" at $2\frac{15}{100}$	"	"

Making an average of the above prices, of $\frac{95}{100}$ of a cent per mile for a ton of 2,000 pounds.

Flour is a large item of the down freight; there is about 120,000 tons sent to market annually, and this, together with provisions, may be taken as a standard of comparison.

Flour has been carried from Rochester to Albany, 269 miles, by transient boats, as low as 18 or 20 cents per barrel, exclusive of tolls; we are informed, however, that contracts for freight to a large amount, have been made by millers at Rochester, with the established lines of forwarding merchants, for the ensuing year, at 24 cents per barrel, from the first of June to the first of October; before and after those periods, at 30 cents per barrel for flour, exclusive of tolls.

For this comparison we will take an average between these two prices, which is 27 cents per barrel, and this is believed to be about the average price paid for freight on the whole tonnage of the Erie canal during the season of navigation.

At the above rates the prices of transportation on the three

canals, exclusive of tolls, would be, for a ton of 2,240 pounds, as follows, viz:

On the Erie canal	1.04	cents per ton	per	mile,
On the the Delaware and Hudson	1.041	"	"	"
Schuylkill	1.00	"	"	"

or an average of a little over one cent per ton per mile, on the three canals.

For a more perfect comparison of the cost of transportation, we will reduce these canals to a level, by an allowance of 20 feet of lockage on the Erie and Schuylkill, as equal to a mile of distance, and in consequence of the less crowded navigation, of 30 feet to the mile on the Delaware and Hudson canal.

The distance on the Erie canal from Rochester to Albany, is 260 miles and the lockage 626 feet, and reduced to a level would be equal to $300\frac{3}{10}$ miles.

The Schuylkill canal is 108 miles long, and 588 feet of lockage, and reduced to a level in the above mentioned ratio, is equal to $137\frac{4}{10}$ miles.

The Delaware and Hudson is 108 miles long, and has 1,073 feet of lockage, and is equal to $135\frac{8}{10}$ miles of level canal.

On a level canal, the prices of freight would be for the

Erie canal	$\frac{828}{1000}$ of a cent	per ton	per	mile,
Schuylkill	$\frac{785}{1000}$	"	"	"
Delaware and Hudson	$\frac{766}{1000}$	"	"	"

and the average price of the three canals would be, without toll, $\frac{937}{1000}$, or a little less than $\frac{8}{10}$ of a cent per ton per mile.

In Hazard's Register, vol. 15, page 112, it is stated that the Lehigh, the Delaware, and Delaware and Raritan canals paid last year $\frac{1}{10}$ of a cent per ton per mile, for the transportation of 105,000 tons of coal; the contractor finding everything, except paying the tolls.

General Remarks.

Having presented such facts as are within our knowledge, with the circumstances connected with them; together with such explanations of principles, as appeared to us necessary to a correct understanding of the subject in its practical character, we have not thought it would aid in the object of enquiry, to attempt any precise ratio of comparative cost of construction or repairs, between canals and railroads: the reason for this is to be found in the obvious modification to which any ratio must be exposed,

in the varied local circumstances that will be encountered in the progress of improvements of this character, and whose tendency would render any ratio of little or no practical value. We, therefore, refer to the several statements, and particularly the tabular views, for information, which we believe when applied to any known case, will afford some useful hints in regard to the relative merits of the two different modes of facilitating internal communication. We may, however, be permitted to state, what appears conclusive from the facts presented, that canals, on the average, have thus far, cost less than railroads, both in their construction and repairs.

In regard to their relative merits as affording the means of transportation, there is less difficulty in reaching an approximate ratio. In reducing them both to a level, we attain for general purposes, a fair standard of comparision. Taking the facts we have obtained as a basis, we find the relative cost of conveyance is, as 4.375 to 1, a little over four and one-third to one, in favor of canals: this is exclusive of tolls or profits. If the cost of construction, the annual cost for repairs, and the amount of tonnage were the same on a canal as on a railroad, then the same rate of toll would produce the same rate of profit on each. Our examinations have shown, as before stated, that railroads in the average, cost more than canals, both in their construction and repairs. But for comparison, we assume a case in which they are equal, and charge the same toll. The average tolls on the Erie canal are less than one cent per ton per mile: assuming an average toll of one cent per ton per mile, the ratio of the entire cost of transportation and toll is, as (2.5 to 1,) two and a half to one, in favor of canals. In the preceding computations, the cost of transportation on railroads is the net cost, as reported by railroad companies, allowing no profit on this business, while the charges on the canals are at contract prices, which are supposed to yield a profit to the carrier. The cost of transportation on canals, as previously stated, is the average on the Erie canal, the Delaware and Hudson canal, and the Schuylkill canal; on the two latter, the cost of transporting coal only is known; and the total average of the three canals is almost exactly the same as the average price for the several different articles transported on the Erie canal. The preceding calculations are confined to a velocity not much exceeding 50 or 60

miles in 24 hours. We have not instituted any investigation to show the relative economy in high and low velocities. For the conveyance of freight, we are of the opinion, canals are not well adapted to any material increase of speed beyond three miles per hour; and as the speed on half of the railroads embraced in this computation, is from ten to fifteen miles per hour, we may consider this comparison as nearly similar to one of high velocity on railroads, and low velocity on canals. And goods that can afford to pay the difference above indicated, for the saving of time, would hold the two kinds of conveyance in equilibrium. The amount that would find so great an object in the saving of time, in comparison to the total quantity requiring transportation, it is believed would be small. In relation to the conveyance of passengers, the saving of time is highly important, and the railroad becomes eminently the superior method of communication. We are therefore led to the conclusion that in regard to the cost of construction and maintenance, and also in reference to the expense of conveyance at moderate velocities, canals are clearly the most advantageous means of communication. On the other hand, where high velocities are required, as for the conveyance of passengers, and under some circumstances of competition, for light goods of great value, in proportion to their weight, the preference would be given to a railroad.

It may be observed in favor of railroads, that they admit of advantageous use in districts where canals, for the want of water, would be impracticable. This advantage often occurs in mining districts, and sometimes, for general trade, where it is necessary to cross dividing ridges at a level too high to obtain water for their summits.

The facts and reasonings presented, we believe, clearly show that both canals and railroads are highly important means of internal communication; that each has its peculiar advantages, and will predominate according to the character of the route, and the trade for which it is intended to provide.

Respectfully submitted,

JOHN B. JERVIS,
HOLMES HUTCHINSON,
FREDERICK C. MILLS,
Civil Engineers.

Albany, 14*th March*, 1835.

Comparison of Rates of Transportation.

	Ton of 2,000 pounds. Price per ton per mile. cts. mills.	Cost if carried 200 miles.
Prices of transportation during the years 1817, 1818, 1819, by teams from Albany to Buffalo, (usual rates, $4.25 pr cwt.,)	29.3	$58 60
Rates of 1835, (including tolls,):		
By Erie canal—		
For merchandise,	3.95	7 90
flour,	1.83	3 66
staves,	0.97	1 94
salt,	0.93	1 86
Baltimore and Ohio railroad—		
Down freight,	4.0	8 00
Up do	6.0	12 00
Liverpool and Manchester railroad—		
For merchandise,	7.5	15 00
Hudson river, 145 miles—		
Heavy goods, (from N. Y. to Albany, 10 cts. per 100 lbs.)	1.38	2 76
Light do 20 do do	2.76	5 52
Provisions, &c., 7 do do	0.96	1 92
Lake Ontario—		
Merchandise, (from Oswego to Lewiston, 146 miles. 20 cts. per 100 lbs. all kinds,)	2.74	5 48
Lake Erie—		
Merchandise, (from Buffalo to Cleveland, 190 miles, 23 cts. per 100 lbs.) for heavy goods,	2.42	4 84
29 cts. per 100 lbs. for light goods,	3.00	6 00

(A.)

Description and cost of certain Canals and Railroads in England, and the prices of stock at various periods.

NAMES OF THE SEVERAL CANALS, RAILROADS AND LINES OF NAVIGATION.	Total cost in pounds sterling.	Costs per mile.	Length of each canal in miles.	Lockage in feet.	Date of completion.	Original cost of each share in pounds sterl'g.	Price of each share in 1821.	Dividend on each share at that time.
Ashton and Oldham	£172,920⅔	£15,720	11	152	1796	97⅞	....	....
Ashby de-la-Zouch	167,466	4,186	40	....	....	113	....	....
Barnsley	97,000	6,466	15	120	1812	160	£300	£13 0 0
Birmingham	115,000	5,111	22½	204	1772	100	203	12 10 0
Bridgewater	....	....	40	82	1776	....	....	....
Chesterfield	160,000	3,478	46	380	1776	100	150	8 0 0
Coventry	120,000	4,444	27	96	1790	100	1,200	44 0 0
Cromford	80,000	4,444	18	80	1794	100	400	19 0 0
Chelmer and Black Water	40,000	3,077	13	....	....	100	....	....
Derby	90,000	10,000	9	78	1794	100	150	7 10 0
Dudley	206,075	15,852	13	....	1797	100	....	....
Ere wash	23,100	....	11¾	108⅔	1797	100	1,400	72 0 0
Ellsmere and Chester	400,000	7,017	57	....	....	133	....	....
Forth and Clyde	421,525	12,043	35	321	1790	100	570	25 0 0
Glamorganshire	60,000	2,400	25	300	....	100	250	13 12 8
Grand Junction	2,000,000	21,390	93½	796	1805	100	307	13 0 0
Grantham	124,000	3,348	33¾	140	1799	150	215	9 0 0
Grand Derbentures	....	....	....	....	....	100	....	....
Grand Union	284,950	....	....	....	....	100	....	....
Kennet and Avon	420,000	5,384	78	263	1801	39⅞	....	....
Leeds and Liverpool	600,000	6,153	130	841	1774	100	395	16 0 0
Leeds and Liverpool, new	200,000	....	....	....	....	80	....	....
Leicester	84,000	3,907	21½	230	....	100	325	17 0 0
Lancaster	614,000	8,105	75¾	287	1803	47½	....	....
Leicester and Northampton	300,000	6,857	43¾	307½	....	83½	....	....
Loughborough	7,000	736	9½	41	1776	100	4,000	200 0 0
Melton and Mowbray	41,000	....	....	....	....	100	240	11 0 0
Mersey and Erwell	50,000	1,000	50	....	....	100	825	35 0 0

Monmouthshire	275,330	15,512	$17\frac{3}{4}$	1,057	1796	100	215	10 0 0
Monkland	10,100	841	12	96	....	100	....	....
Montgomeryshire	92,000	3,407	27	....	....	100	....	....
Neath	35,000	2,500	14	....	1798	100	350	15 0 0
Nottingham	75,000	5,000	15	....	1802	150	290	12 0 0
Oxford	330,000	3,473	$91\frac{1}{2}$	269	1790	100	670	32 0 0
Peak Forest	150,000	6,521	23	....	1800	78	....	....
Regents or London	400,000	57,143	7	90	....	$33\frac{7}{8}$	....	....
Rochdale	291,900	8,842	33	$613\frac{1}{2}$	....	85	....	....
Shrewsbury	70,000	4,000	$17\frac{1}{2}$	155	1797	125	210	10 0 0
Shropshire	47,500	6,333	$7\frac{1}{2}$	453	1792	125	135	7 0 0
Somerset Coal	185,000	10,571	$17\frac{1}{2}$	138	1802	50	170	10 0 0
Somerset Lock Fund	45,000	....	....	....	....	$12\frac{1}{2}$	....	....
Stafford and Worcester	100,000	2,150	$46\frac{1}{2}$	394	1772	140	800	40 0 0
Stourbridge	30,000	6,000	5	191	1776	145	220	12 0 0
Stroudwater	20,000	2,500	8	108	1796	150	450	23 0 0
Swansea	90,000	5,142	$17\frac{1}{2}$	366	1798	100	280	12 10 0
Trent and Mersey	334,250	3,594	93	778	1772	100	820	37 10 0
Warwick and Birmingham	180,000	7,200	25	....	1799	100	265	12 0 0
Warwick and Napton	130,000	8,666	15	....	1799	100	205	12 0 0
Wyrley and Essington	160,000	6,956	23	288	1794	125	160	6 0 0
Worcester and Birmingham	470,250	16,215	29	428	....	$78\frac{3}{8}$	....	....
COST OF RAILWAYS IN ENGLAND AND PRICES OF STOCK AT SAME DATES.								
Cromford and Peak Forest	168,707	5,191	$32\frac{3}{4}$	1,800	1831	100	....	....
Canterbury	....	....	....	....	....	50	....	....
Cheltenham	....	....	....	....	....	100	....	....
Croydon	....	....	....	....	1803	65	....	....
Clarence, (Durham)	....	....	....	....	....	100	....	....
Forest of Dean	....	....	....	....	....	50	....	....
Grand Junction	....	....	....	....	....	20	....	....
Jersey	....	....	....	....	....	60	....	....
London and Greenwich	....	....	....	....	....	4	....	....
Leicester and Swanington	....	....	....	....	....	50	....	....
Liverpool and Manchester	....	....	....	....	1830	100	....	....
do do	$1,089,813\frac{3}{4}$	....	31	379	....	25	....	....
do do	....	....	....	....	....	25	....	....
London and Birmingham	....	....	....	....	....	5	....	....
Monmouth	....	....	....	....	....	50	....	....
Severn and Wye	....	....	....	....	....	50	....	....
Stockton and Darlington	130,000	5,200	25	....	....	100	....	....
St. Etienne and Lyons*	1,370,954 19	$40,086 38	$34\frac{1}{4}$	....	1831			

A.—Continued.

NAMES OF THE SEVERAL CANALS, RAILROADS AND LINES OF NAVIGATION.	Price of the same in March 1828.	Dividend at the same time.	Price of each share Nov. 1, 1851.	Dividend at the same time.	Price of each share in 1833.	Dividend at the same time.	Price of each share, October 21, 1834.	Dividend at the same time.
Ashton and Oldham					£160	£6 0 0	£160	£6 0 0
Ashby de-la-Zouch					74	4 0 0	65	4 0 0
Barnsley			£210	£10 0 0	290	13 0 0	272	13 0 0
Birmingham	£565	£20 0 0	244	12 10 0		12 10 0	235	12 10 0
Bridgewater								
Chesterfield	120	8 0 0	170	8 0 0				
Coventry	999	44 0 0	750	50 0 0	610	32 0 0	806	42 0 0
Cromford			410	19 0 0				
Chelmer and Black Water					102	5 0 0	102	5 0 0
Derby			120	6 0 0				
Dudley					60	2 10 0	67	3 5 0
Ere wash	1,000	58 0 0	600	54 0 0				
Ellsmere and Chester					80	3 15 0	87	3 15 0
Forth and Clyde			600	27 0 0	560	25 0 0	560	25 0 0
Glamorganshire			290	13 12 8	290	13 12 4	290	13 12 4
Grand Junction	218	9 0 0	235	13 0 0	241	12 0 0	242	12 0 0
Grantham			195	9 0 0	202	10 0 0	202	10 0 0
Grand Derbentures						5 0 0	76	4 0 0
Grand Union					23	1 0 0	23	1 0 0
Kennet and Avon					$28\frac{1}{4}$	1 5 0	$25\frac{1}{4}$	1 5 0
Leeds and Liverpool	278	10 0 0	405	20 0 0	$452\frac{1}{2}$	20 0 0	515	20 0 0
Leeds and Liverpool, new								16 0 0
Leicester	260	10 0 0	211	17 0 0	185	13 0 0	170	12 0 0
Lancaster					27	1 0 0	25	1 0 0
Leicester and Northampton					82	4 0 0	82	4 0 0
Loughborough	2,400	119 0 0	2,550	180 0 0	1,820			136 0 0
Melton and Mowbray	170	8 10 0	190	2 10 0	190	9 0 0	200	10 0 0
Mersey and Erwell	650	30 0 0	525	40 0 0	720	40 0 0		40 0 0
Monmouthshire			208	12 0 0		10 0 0	191	11 0 0
Monkland			90					
Montgomeryshire					86	4 0 0	90	4 0 0

Neath	....	....	300	18 0 0	....	....	300	15 0 0
Nottingham	....	....	245	12 0 0	....	....	....	
Oxford	640	32 0 0	510	32 0 0	....	32 0 0	610	32 0 0
Peak Forest	....	....	....	....	71	3 0 0	90	3 10 0
Regents or London	....	....	....	....	17	0 13 6	17	0 13 6
Rochdale	....	....	....	....	....	4 10 0	124½	4 10 0
Shrewsbury	....	....	205	11 0 0	255	11 0 0	205	11 0 0
Shropshire	....	....	140	8 0 0	136	7 10 0	106	7 10 0
Somerset Coal	....	....	160	10 10 0	....	10 0 0	170	10 0 0
Somerset Lock Fund	....	....	....	....	13	6 5 0	13	
Stafford and Worcester	642	40 0 0	155	36 0 0	600	34 0 0	645½	36 0 0
Stourbridge	....	....	220	11 0 0	200	8 0 0	....	8 0 0
Stroudwater	....	....	480	23 0 0	525	24 0 0	525	24 0 0
Swansea	....	....	203	15 0 0	220	11 0 0	215	12 0 0
Trent and Mersey	900	75 0 0	620	37 10 0	660	37 10 0	640	32 10 0
Warwick and Birmingham	210	11 0 0	230	12 0 0	280	16 0 0	280	14 0 0
Warwick and Napton	235	10 0 0	210	12 0 0	210	12 0 0	....	
Wyrley and Essington	....	....	115	6 0 0	115	6 0 0	80	
Worcester and Birmingham	....	....	....	....	87¼	4 0 0	86	4 0 0
COST OF RAILWAYS IN ENGLAND, AND PRICES OF STOCK AT SAME DATES.								
Cromford and Peak Forest	....	....	....	....	....	....	....	
Canterbury	25	....	35	....	....	....	40	
Cheltenham	78	....	78	....	....	....	....	
Croydon	....	....	....	....	....	....	....	
Clarence, (Durham)	....	....	65	....	100	....	70	
Forest of Dean	45	2 16 0	33	2 4 0	25	1 2 0	....	0 19 0
Grand Junction	....	....	....	....	....	....	20½	
Jersey	....	....	....	....	....	....	....	
London and Greenwich	....	....	....	....	4	....	7¾	
Leicester and Swanington	....	....	....	....	57	....	58	
Liverpool and Manchester	....	....	205	8 0 0	210	8 4 0	199	9 0 0
do do	....	....	....	....	51½	....	48½	
do do	....	....	....	....	51	....	48½	
London and Birmingham	....	....	....	....	13¾	....	15¾	
Monmouth	....	....	....	....	....	....	....	
Severn and Wye	23	1 11 0	117	0 17 0	16½	0 17 4	19½	1 0 0
Stockton and Darlington	160	5 0 0	230	6 0 0	297½	8 0 0	250	8 0 0
St. Etienne and Lyons*								

* In France. Has 14 tunnels, one a mile in length, another 2,990 ft. under the river Degier; one bridge over the Soane, cost 17,000 francs. Wrought iron rails, chains cast, supported in stone blocks, Clarence rail. The fractional parts of a £ in the column of cost per mile omitted.

REMARKS.

Ashton and Oldham.—The summit pond is six feet deep and serves as a reservoir.

Ashby de-la-Zouch.—Two tunnels, one of 700 and the other 200 yards in length.

Birmingham.—Two tunnels, one of 1,000 and one of 2,078 yards in length—184 under the hill.

Bridgewater.—Tunnel of 18 miles in Worsley hills; estimated £168,960; profits of canal, 50 to £80,000.

Chesterfield.—Two tunnels, one of 2,850 and one of 153 yards in length.

Coventry.—Connected with the summit level of this canal is the longest level in England, 82 miles, including side branches.

Cromford.—Tunnel of 3,000 yards in length, cost £7 per yard; there are several other tunnels; three reservoirs.

Derby.—Cast iron aqueduct.

Dudley.—Three tunnels, one of 3,776, one of 2,926 and one of 623 yards in length.

Ere wash.—Supplied by reservoirs.

Ellsmere and Chester.—Two tunnels, one of 775 and one of 487 yards long. Pont Cysylty cast iron aqueduct 320 feet long, on stone piers 52 feet apart, and the highest 125 feet.

Forth and Clyde.—Two reservoirs, 70 and 50 acres, 22 and 24 feet deep.

Grand Junction.—Five reservoirs for supplying canal; two tunnels, one of 3,080 and one of 2,045 yards in length.

Grantham.—Wholly supplied by reservoirs.

Leeds and Liverpool.—Two tunnels, one of 1,030 yards in length.

Lancaster.—Two tunnels about 800 feet long; aqueduct, five arches, 51 feet high, 70 feet span each; one level 42½ miles long.

Leicester and Northampton.—Four tunnels, 1,056,990,880 and 286 yards in length.

Melton and Mowbray.—Navigation.

Mersey and Erwell.—Navigation.

Monmouthshire.—Railway with inclined planes.

Oxford.—One steam engine, 100 horse power; three tunnels, 1,188, 125—— yards long; three reservoirs on the summit. The summit pond is six feet deep, and also serves as a reservoir.

Peak Forest.—Aqueduct 360 feet, arches 100 feet high; inclined plane 515 yards in length, 204 feet fall.

Rochdale.—Tunnel 70 yards in length, and deep cut of 50 feet in rock; one steam engine and two reservoirs, (one of which is 14 feet deep,) to supply the summit pond. Shrewsbury has one double inclined plane 223 yards in length, 75 feet rise. One tunnel 970 yards in length.

Shropshire.—Three inclined planes, of 207, 126 and 120 yards long, no locks, summit supplied with two reservoirs above, and by steam engines from two other reservoirs below summit.

Somerset Coal.—Upper pond supplied by steam engines.

Stafford and Worcester.—Three short tunnels and two reservoirs for supplying canal.

Stourbridge.—Summit supplied by a reservoir.

Stroudwater.—Has no towing-path.

Trent and Mersey.—Tunnel of 2,888 yards in length; the first canal tunnel in England, and cost £3 10s. 8d. per yard run. There are four other tunnels, 1,241, 572, 350 and 130 yards long, and five reservoirs.

Warwick and Birmingham.—Tunnel, 300 yards in length.

Worcester and Birmingham.—Supplied by steam engine and reservoir; one tunnel of 2,700 yards in length; four others of 500, 400, 120 and 110 yards long.

Cromford and Peak Forest.—Has nine inclined planes, overcomes 1,800 feet rise and fall. Several tunnels, one of 1,590 yards in length. The cast rails weigh 63 lbs. per yard.

Liverpool and Manchester.—Cost including carriages, engines, warehouses, &c.

Stockton and Darlington.—From the river Tees to Darlington coal mines, the expense is exclusive of branches, the cost of land and their charter. These cost about £25,000.

(B.)

Description, cost, tolls, &c., of various canals in the United States.

NAMES OF CANALS.	Dimensions.											
	Length of main canal.	Length of navigable feeders and side cuts.	Total length, including feeders.	Depth of water.	Width of surface.	No. of locks.	Length of locks.	Width of locks.	Lockage on main canals.	Lockage on feeders and side cuts.	No. and feet of dams.	When completed.
1. NEW YORK CANALS.												
Erie	363	8	371	4	40	84	90	15	689	....	....	1825
Champlain	64	....		4	40	21 5g.	97	14	163½	....	No. 4 4,900	1824
Glens Falls feeder	....	12	79	4	30	13	97	14	....	132	1 800	1829
Side cut at Waterford	....	....		4	40	3	97	14	....	35	....	......
River navigation above Troy dam	....	3		......	......	1	130	22	....	9	1 1,200	1824
Oswego	38	....	38	4	40	14	90	15	123	....	8 5,667	1828
Cayuga and Seneca	21	2	23	4	40	11	90	15	73	7	....	1828
Chemung	23	16	39	4	42	53	90	15	488	28	1 630	1833
Crooked Lake	8	....	8	4	42	27	90	15	269	....	1 50	1833
Totals	....	....	558	......	......	....	......	....	1,805½	211	....	......
Chenango	97	....	97	4	42	109	90	15	1,021	....	....	......
Constructed by an incorporated Co.												
Delaware and Hudson	108	....	108	4	36	110	76	9	1,073	....	....	1828
2. PENNSYLVANIA CANALS.*							95					1830
Delaware division	59¾	....	59¾	5	40	23		11	164	....	....	
Eastern division	43	....	43	4	40	....	90	17	......	......	1 1,998	1831
									682			
Junietta division	128	4½	132½	4	40	....	90	15 ri. 17	......	......	4 2,250	1830

Western division	105		$106\frac{1}{2}$	4	40		90	15	444			1830
Feeder above Johnstown		$1\frac{1}{2}$										
Susquehanna division	39		39	$4\frac{1}{2}$	43		90	17	87			1831
West Branch division	$25\frac{3}{4}$		$25\frac{3}{4}$	4	40	61. 1g.	90	17	41			1830
North Branch division	$55\frac{1}{2}$		$55\frac{1}{2}$	4	40	71. 1g.	90	17	88			1830
Wyoming division	17	$\frac{1}{4}$	$17\frac{1}{4}$	4	40		90	17	43			1832
Lycoming (or West branch)	$41\frac{3}{4}$	$4\frac{1}{4}$	46	4	40	14	90	17	90	21		
Beaver	$30\frac{3}{4}$		$30\frac{3}{4}$	4	40	18	90	18	$144\frac{1}{2}$		7	
Franklin Line	$22\frac{1}{4}$		$22\frac{1}{4}$	4	40							
French Creek division	$23\frac{1}{2}$		$23\frac{1}{2}$	4	40	171. 4g.	90	18	$128\frac{1}{2}$			
Totals			$601\frac{1}{2}$						$1,912\frac{1}{2}$	21		
Constructed by incorporated Co's.												
Schuylkill	108		108	4	36	921. 28g.	80	17o $8\frac{1}{2}$	588		31	1825
Union	80	24	108	4	36	91	75	$13\frac{1}{2}$	$503\frac{1}{2}$	16		1828
Railroad		4										
Lehigh	$46\frac{3}{4}$		$46\frac{3}{4}$	5	60	471. 6g.	100	22	$360\frac{7}{8}$		8	1829
Conestoga Navigation	18		18				100	22				
Totals			$280\frac{3}{4}$						145,237	16	39	
3. OHIO CANALS.												
Ohio (Main Trunk)	$308\frac{1}{4}$	$25\frac{1}{4}$	400	4	40	152	90	15	$1,207\frac{1}{3}$	$52\frac{2}{3}$		1832
	Side cut.											
Miami	66	$\frac{1}{2}$		4	40	32	90	15	297			1832
Totals	$374\frac{1}{4}$	$25\frac{3}{4}$	400			184			$1,504\frac{1}{3}$	$52\frac{2}{3}$		
Constructed by incorporated Co's.												
4. KENTUCKY.												
Louisville and Portland	2		2		200	31.	183	50	24			1831
						1g.	190	50				
5. MARYLAND.												
Chesapeake and Ohio	5	To Little Falls.		7	80	441. 4g.	100	15	353		5	1834
	60	Harp's Ferry ..		5	60							
	44	Total.....	109	5	50							
6. VIRGINIA.												
James and Jackson rivers	$30\frac{1}{2}$		$30\frac{1}{2}$	$3\frac{1}{2}$	40							1825
Irish Falls	7		7	$3\frac{1}{2}$	40				96			1825

* Total amount of tolls received on Pennsylvania State canals, including $118\frac{3}{4}$ miles railroad, during the fiscal year of 1833 (as per Canal Commissioners' report of 1834), is $151,419.69. For 1834, the total amount is $322,535.08.

B.—Continued.

NAMES OF CANALS.	Dimensions.											
	Length of main canal.	Length of navigable feeders and side cuts.	Total length, including feeders.	Depth of water.	Width of surface.	No. of locks.	Length of locks.	Width of locks.	Lockage on main canals.	Lockage on feeders and side cuts.	No. and feet of dams.	When completed.
VIRGINIA.—Continued.												
Dismal Swamp	22½		......	......	......	......	......	......	......	......	......	......
Lake Drummond (feeder)	......	*5	27½	6½	40	......	100	22	33	......	......	1822
	60	5	65	......	......	......	......	......	......	......	......	......
7. SOUTH CAROLINA.												
Santee canal	22	......	22	4	32	13	60	10	103	......	......	1802
8. DELAWARE.												
Chesapeake and Delaware	14	......	14	......	66	21. 2 tide.	100	22	24	......	......	1829
9. NEW JERSEY.												
Delaware and Raritan	43	......	......	......	......	......	......	......	......	......	......	......
Feeder to said canal	......	22	65	7	75	14l. 1g.	110	24	116	......	1	1834
				[illegible]	50	......	......	......	10½			
Morris canal	101	......	101	4	32	24 locks.	75	9	223	......	[illegible]	1832
						23 plains.			1,334			
	144	22	166	......	......	......	......	......	1,683	......	......	......
10. NEW ENGLAND.												
Cumberland and Oxford	20½	......	20½	4	34	26	80	10	260	......	......	1829
Blackstone	45	......	45	4	34	48	80	10	451 6-10	......	......	1828
Middlesex	27	......	27	3	30	20	75	12	136	......	......	1808
Farmington	58	......	78	4	36	......	80	12	218	......	......	1828
Hampshire and Hampden	20								298	......	......	1833
Totals	......	......	170½	......	......	......	......	......	1,363 6-10	......	......	....

* Not navigable.

B.—Continued.

NAMES OF CANALS.	Cost per mile.	Total cost.	Tolls in 1833.	Tolls in 1834.	Total amount of tolls received.
1. NEW YORK CANALS.					
Erie	$19,255 49	$7,143,789 86	$1,290,136 20	$1,179,744 97	
Champlain Glens Falls feeder Side cut at Waterford River navigation above Troy dam	15,520 95	1,257,604 26	132,559 02	115,211 89	$10,535,613 19
Oswego	14,879 93	565,437 35	22,950 47	22,168 02	105,708 08
Cayuga and Seneca	10,295 85	236,804 74	17,174 69	18,130 43	83,029 55
Chemung	8,504 96	331,693 57	694 00	3,378 05	4,072 05
Crooked Lake	19,597 11	156,776 90	200 84	1,473 40	1,674 24
Totals		$9,692,106 68	$1,463,715 22	$1,340,106 76	$10,730,097 11
Chenango	$20,210 87	$1,960,456 28			
	20,665 00	2,231,820 00			
Constructed by an incorporated Co.					
Delaware and Hudson					
2. PENNSYLVANIA CANALS.					
Delaware division	$20,720 12	$1,238,027 69			
Eastern division	29,854 26	1,283,733 46			
Junietta division	18,830 17	2,490,290 13			
Western division	25,088 51	2,758,937 71			
Feeder above Johnstown		64,255 00			
Susquehanna division	26,647 60	1,039,256 77			
West Branch division	16,379 45	421,771 00			
North Branch division	19,732 94	1,096,178 34			
Wyoming division	20,164 50	342,796 55			
Lycoming (or West Branch)	28,876 01	1,205,573 77			
Beaver	15,492 08	476,401 48			

B.—Continued.

NAMES OF CANALS.	Cost per mile.	Total cost.	Tolls in 1833.	Tolls in 1834.	Total amount of tolls received.
PENNSYLVANIA CANALS.—Continued.					
Franklin Line	$19,890 26	$442,558 34			
French Creek division	18,785 33	441,455 45			
Totals		$13,301,235 69			
Constructed by incorporated Co's.					
Schuylkill					
Union	$16,741 26	$1,808,056 17	$325,486 63	$299,841 00	
Railroad	18,518 51	2,000,000 00	103,462 45	119,870 53	
Lehigh	33,610 75	1,546,094 96			
Conestoga navigation	3,807 77	68,539 92			
		$5,422,691 05			
3. OHIO CANALS.					
Ohio (Main Trunk)			$136,092 70	$159,977 23	
	$10,473 84	$4,189,539 64			
Miami			50,470 63	50,040 99	
Totals			$186,563 33	$210,018 22	
Constructed by incorporated Co's.					
4. KENTUCKY.					
Louisville and Portland					
5. MARYLAND.					
Chesapeake and Ohio	$37,291 12	$4,164,732 04			

6. VIRGINIA.					
James and Jackson rivers	$20,435 77	$623,295 00			
Irish Falls	48,571 43	340,000 00			
Dismal Swamp					
Lake Drummond (feeder)	16,000 00	360,000 00			
		$1,323,295 00			
7. SOUTH CAROLINA.					
Santee canal	$29,575 78	$650,667 00			
8. DELAWARE.					
Chesapeake and Delaware	$157,142 85	$2,200,000 00			
9. NEW JERSEY.					
Delaware and Raritan					
Feeder to said canal	$37,417 91	$2,500,000 00			
Morris canal	19,703 04	1,990,007 19			
		$4,490,007 19			
10. NEW ENGLAND.					
Cumberland and Oxford	$10,292 68	$211,000 00	$16,475 70	$14,468 51	
Blackstone	13,333 33	600,000 00			
Middlesex	19,555 55	528,000 00			
Farmington } Hampshire and Hampden }	10,897 44	600,000 00 / 250,000 00			
Totals	$12,838 71	$2,189,000 00			

Remarks.

New York Canals.

Erie.—From Lake Erie to the Hudson river; has cut stone locks; feeders, 4 ft. deep, 28 ft. surface.

Champlain.—From Lake Champlain to the Erie canal at the Junction; has 7 lift locks from lake to summit=54 feet, and 14 locks from summit to the Hudson=134; locks of cut stone, dam at Fort Edward across the Hudson, 28 ft. high, 900 ft. long, with short feeder and guard lock; 4 other guard locks, 1 at Saratoga dam, (the dam is about 1,390 ft. long,) 1 at Fort Miller dam, and 2 at the Mohawk dams; locks of Glens Falls feeder are of wood.

Side Cut at Waterford.—From Waterford to Troy; 3 cut stone locks at Waterford; side cut of same dimensions as main canal; one at Troy dam, 9 ft. lift.

Oswego.—From Erie canal to Lake Ontario; about half the distance slack water or river navigation, with towing path on the bank; has 14 lift locks of cut stone, 2 of them used as guard locks; there are, also, 6 guard locks of 17 feet wide and 90 ft. long, 1 of which is of wood, the others of hammered stone.

Cayuga and Seneca.—From the Erie canal at Montezuma to Geneva; one-half slack water navigation, and 2 miles of side cut to Cayuga lake; locks of wood.

Chemung.—From Seneca lake to Elmira; has 1 guard lock, which connects the feeder with the Chemung river, at Chimney narrows; locks of wood; original estimate for the work $331,-125, excess $568.57.

Crooked Lake.—Connects Crooked lake, which is 20 miles long, (having a branch of 7 miles,) with the Seneca lake at Dresden; locks of wood.

N. B.—Average cost per mile of the above canals is $17,367.57.

Chenango.—From the Erie canal at Utica to the Susquehanna at Binghamton; to be completed in 1836; cost, as per astimate of 29th December, 1834, (see rep. of Canal Commissioners, 1835,) exclusive of land damages; composite locks.

Delaware and Hudson.—From the Hudson at Kingston to Honesdale in Pennsylvania; 16 miles of railroad extends this improvement to the Lackawanna coal mines; has 60 locks of hammered stone, and 50 composite.

Pennsylvania Canals.

Delaware Division.—From Bristol to Easton; beside the lift locks on main line, there are 2 guard and 1 outlet lock (at Easton) and a tide lock at Bristol; the locks are of stone, laid in cement, and faced with timber and plank.

Eastern Division.—From Columbia to Duncan's Island; a dam at said island 1,998 ft. long, 8½ ft. high; cost $18,421.60; has 19 aqueducts, 1 of which is cast iron; locks of stone.

Junietta Division.—From Duncan's Island to Hollidaysburg; has 35 lift locks, 3 guard, 1 outlet and 4 river locks below Huntington; there are 4 dams, and in all about 15 miles slack water navigation.

Western Division.—From Johnstown to Pittsburg; the Portage railroad (36¾ miles) connects this division with the Junietta division; has 2 expensive aqueducts, and a tunnel over 1,000 feet in length.

Susquehanna Division.—From Duncan's Island to Northumberland.

West Branch Division.—From Northumberland to above Muncy rapids.

North Branch Division.—From Northumberland to Nanticoke dam.

Wyoming Division.—From Nanticoke dam to the Wilksbury and Lackawana coal beds.

Lycoming (*or West Branch*).—From Muncy to Bald Eagle; has 2 side cuts; the Bald Eagle side cut at the northerly termination of said canal, is 3¾ miles long, and the Lewisburgh side cut, which has 21 ft. lockage by 3 locks, is ½ mile long.

Beaver.—From Ohio river to Newcastle in Mercer county; two-thirds slack water navigation up Beaver and Chenango creeks.

Franklin Line.—From Franklin on the Allegany to French creek feeder, has 17 miles of slack water navigation; the outlet lock at Franklin is 22 ft. wide and 120 ft. long.

French Creek Division.—Connects the Franklin line with the Conneaut lake.

N. B.—Average cost per mile of the above State canals, is $22,113.44.

Schuylkill.—From Philadelphia to Mount Carbon; it has 1 reservoir 41 ft. deep, and 1 tunnel of 450 ft. in length; 46 miles of slack water navigation; the total cost of the work, including improvements, up to 1st Jan., 1830, is $2,336,380.

Union.—From the Schuylkill to Middletown on the Susquehanna; it has 1 tunnel 243 yds. long, 18 by 14 ft., 3 reservoirs, and 2 engines, 100 horse power each, for supplying the summit level; one of the reservoirs has an embankment and dam 50 ft. high, contains 1,000 ac.

Lehigh.—From Easton to Mauch Chunk; has 9¾ miles slack water navigation; the 4 locks nearest Mauch Chunk are 30 feet wide by 130 ft. long; the others, as noted in the table, 2 of which are used as guard locks; locks of stone in cement, faced with timber and plank; also, 4 aqueducts and 22 culverts. In 1833 there was shipped on this canal, from Manch Chunk, 122,928 tons of coal.

Canastoga navigation.—Extends from Safe Harbor on the Susquehanna river to Lancaster, and is effected by a series of locks and dams.

N. B.—The 3 first canals, viz: Schuylkill, Union and Lehigh, average $20,377.36 per mile; including the Canastoga navigation, the average cost is $19,315 per mile.

Ohio Canals

Ohio (Main Trunk).—Main trunk from Lake Erie to the Ohio river at Portsmouth; it has 9 guard locks, 4 feeders on the Cuyahoga summit, and 1 reservoir, formed by three small lakes, containing 350 acres, and 1 side cut, and 1, principally artificial, of 2,000 acres, 6 ft. deep, on the Licking summit. The Miama canal extends from Cincinnati to Dayton. Upon these improvements are 22 aqueducts, 182 culverts of stone masonary, and 60 of wood, and 9 dams for crossing streams, and 12 feeder dams; locks of stone, cut; the Ohio river at Portsmouth is 413 feet below the Licking summit, 49 ft. below Portage summit, 96 lower than Lake Erie, 98 lower than the mouth of the Muskingum, and 468 feet above the tide at Albany.

Constructed by Incorporated Companies.

Kentucky.

Louisville and Portland.—Around the falls of Ohio; is intended for steamboats of the largest class; the guard and lift locks are combined; walls are 20 ft. high, except the guard lock, which is 42 ft. high, and corresponds with the height of the banks; the entire length of the walls is 921 ft., containing 34,075 perches of

masonry, 21,775 perches of which are in the guard lock; there are, also, 3 stone culverts and 2 bridges, 1 of stone, 240 ft. long, with an elevation of 68 ft., 3 arches, and contains 5,741 perches of mason work; the other is a pivot bridge over the head of the guard lock, and is of wood, 100 feet long, with a span of 52 ft. Total amount of mason work, 41,982 perches, equal to about 30 common canal locks.

Maryland.

Chesapeake and Ohio.—From Tiber creek in Washington city, to a point 8 miles west of Williamsport; the distance remaining to be completed to Pittsburg, is 233 miles; the total amount of lockage is 3,158 ft.; on the first 48 miles (to Point of Rocks) the lockage is 217 ft. by 27 locks; pivot bridges have been substituted for permanent ones, in order to avoid annoyance in the conveyance of passengers; there are, also, 4 aqueducts, No. 1 Seneca, cost $22,784; No. 2, Monocacy, 9,788 perches, cost $125,000: No. 3, Catoclin, cost $33,500; No. 4, Antietam, $22,850; total cost, $204,134; and 151 culverts, which cost from $3.50 to $5.50 per perch of 25 ft.; the canal has 5 principal feeders from the Potomac, and 4½ miles slack water navigation; locks of cut stone. The total cost of this work (342 miles), as estimated by United States engineers, $22,375,427.69; estimated by Geddes and Roberts, $9,347,408.69.

Virginia.

James and Jackson Rivers.—From basin at Richmond to a fall in Goveland county.

Irish Falls.—Around Irish falls to the mouth of the North branch, on James river.

Lake Drummond (feeder).—From Chesapeake bay to Albermarl sound; part in Virginia and part in North Carolina; its dimensions have since been enlarged; every other ¼ of a mile the canal is widened to 60 ft. for turn-out stations; the summit is 16½ ft. above the Atlantic at half tide, and is supplied by a feeder of 5 miles in length from Lake Drummond; the basin at Deep creek is ½ mile long, and 15 ft. above tide.

South Carolina.

Santee canal.—From Santee to Cooper's river, by means of Dreln and Louck's canals, Saluda and Broad rivers, and Saluda

acd Columbia canals, navigation is continued from Santee river to Columbia. Winyaw canal unites Santee river with Winyaw bay; length 10 miles.

Delaware.

Chesapeake and Delaware.—It connects the Delaware river, with the Chesapeake bay, and is partly in Delaware and partly in Maryland; at Delaware city a harbor extends 500 ft. along the shore, from which 2 piers, that distance apart, project 250 feet into the river nearly opposite Fort Delaware; has a deep cut of 76 ft. deep, at the summit of which a bridge is constructed over the canal 80 ft. high, 280 ft. span; locks of cut stone.

New Jersey.

Delaware and Raritan.—From New Brunswick to Lamberton; the water to supply this canal is conducted on to the summit by a navigable feeder 22 miles long, extending from Eagle Island on the Delaware to its junction with the main canal at Trenton; locks of stone, cut; canal calculated for 1 ft. additional depth.

Morris canal.—From Jersey city on the Hudson to the Delaware river opposite Easton, Penn., where it connects with the Lehigh canal; there are, also, connected with this canal 4 guard locks, 5 dams, 30 culverts, 12 aqueducts, and more than 200 bridges; the water to supply this canal is obtained from Hopatcong lake, 900 ft. above tide; locks af stone, uncoursed hammer work; 13,000 tons coal transported through this canal in 1833.

New England.

Cumberland and Oxford.—From Portland to the head of Long pond in Oxford county; locks of wood; a lock is constructed in Songo river, by which navigation is continued into Brandy and Long ponds, making the whole water communication 46 miles; has 1 guard lock and a dam across the outlet of Sabago pond.

Blackstone.—From Worcester, Mass., to Providence, R. I.; locks of cut stone; canal supplied with water by 7 reservoirs, having a total area of 4,600 acres, of an average depth of 6 ft.

Middlesex.—From Boston to Merrimack river near Lowell; locks principally of wood.

Hampshire and Hampden.—From Newhaven, Ct., to Northampton, Mass.; locks of wood; at its commencement in New Haven is a basin of 20 acres.

(C.)

Tabular view of the railroads mentioned in the preceding pages, where the authorities for the facts will be found.

NAMES OF RAILROAD.	Length of road.	In direction of greatest trade		Inclined planes worked by stationary power.	Cost per mile.	Cost of repairs per mile per annum.	Cost of trans-port'n per ton per mile.		Cost per mile per passenger.	Completed in the year.	REMARKS. *The roads in this table are all double tracks, made or computed.*
		Ascent.	Descent.				Act'l cost.	Cost re-duced to a level.			
	Miles.	*Feet.*	*Feet.*	*No.*	*Dlls.*	*Dlls.*	*cents.*	*cents.*	*cents.*		
Baltimore and Ohio, to point of rocks. 67½ / Branch to Frederick 3½	71	718	900	4	29,193	382	3.96	3.05	1.85	1831	Inclined planes are yet worked by horse power. Ratio of moving power, as 4 to 10.
Liverpool and Manchester, England.	31	150	229	1	100,000	2,116	4.70	4.07	1.53	1830	Ratio of moving power, as 3 to 10, of the entire cost of transportation.
Baltimore and Washington.	30	. . . . . .	. . . . . .	none.	50,000	. . . .	. . . . . .	. . . . . .	. . . . . .	. . . . . .	Not completed, diverges from the Baltimore and Ohio, about 6 miles from Baltimore.
Columbia and Philadelphia.	82	. . . . . .	. . . . . .	2	40,450	. . . .	. . . . . .	. . . . . .	. . . . . .	. . . . . .	Essentially completed.
Allegany Portage.	36	802	1,202	10	47,977	. . . .	. . . . . .	. . . . . .	. . . . . .	. . . . . .	do do The elevation only embraces the inclined planes, which are together 32,840 feet in length. There are other inclinations not embraced in the planes, amounting to 1,336 feet. Total ascent and descent, 2,570 feet.
Mohawk and Hudson, exclusive of branches	16	115	334	2	38,107	. . . .	3.50	. . . . . .	1.70	1832	
Saratoga and Schenectady, computed for a double road	22	128	45	none.	17,010	. . . .	. . . . . .	. . . . . .	. . . . . .	1832	
Delaware and Hudson Canal Co., Carbondale	16	855	913	8	14,000	623	3.50	3.05	. . . . . .	1829	Computed for a double road; (see remarks on transportation.)
Newcastle and Frenchtown.	16½	. . . . . .	. . . . . .	none.	30,000	. . . .	. . . . . .	. . . . . .	. . . . . .	1831	
Camden and Amboy from Amboy to Bordentown	33	. . . . . .	. . . . . .	none.	30,000	. . . .	. . . . . .	. . . . . .	. . . . . .	1832	
South Carolina.	130	. . . . . .	. . . . . .	1	7,200	. . . .	. . . . . .	. . . . . .	. . . . . .	1833	Believed to be mostly a single track.
Excluding the Liverpool and Manchester road in the cost of construction, the average is.					30,393	1,040	3.91	3.53			

Report on a Ship Canal between Hudson River and Lake Ontario. By Messrs. Jervis, Hutchinson, and Mills, Engineers, March 23d, 1835.

Extracts.

The citizens of Utica presented a memorial to the Legislature, together with a report on the same from E. F. Johnson, Esq., for a steam boat canal from Utica to Oswego, to be ultimately extended to Albany. The memorial asked for a canal 8 feet deep, 58 on bottom, and 90 feet surface, with locks 130 feet long by 30 feet wide.

"In making a comparison between the cost of transportation between canals, lakes and rivers, to determine what power is the best economy, leaving out the item of toll, we have procured the following statement of charges for transportation, which are exclusive of toll on the canal.

	Mills.
For flour per ton per mile Hudson river steam tow boats, (145 miles)	8
For flour per ton per mile Erie canal, (363 miles)	$8\frac{9}{10}$
For flour per ton per mile Erie canal, (269 miles,) to Rochester	$9\frac{2}{10}$
For merchandise per ton per mile Hudson river, recent tariff	$15\frac{1}{10}$
For merchandise per ton per mile Erie canal, recent tariff	$21\frac{1}{2}$
For merchandise per ton per mile Buffalo to Detroit, 1834, (350 miles)	$37\frac{4}{10}$
For merchandise per ton per mile Oswego to Lewiston, 1834, (146 miles)	29

"The above includes port charges. On the Erie canal the cost of animal power is 12 per cent. greater than steam power on the Hudson for flour, and 42 per cent. greater for merchandise; agricultural products, including ashes, 21 per cent. greater on the canal than on Hudson river.

"The Erie canal is small, and the traction of boats that navigate it is from 30 to 45, and most usually 40 per cent. greater than would occur on a canal of the most favorable size for the boat used. That although steamboat navigation could be effected at about one-third less than on the proposed ship canal, the agitation of water by the wheels would be too severe for the banks.

We find that even in England, where steam power is much cheaper than in this country, they adopt animal power, not only on small, but *large canals.* From the facts given, we are irresistibly led to the conclusion that the use of steam power on the proposed improvement is inexpedient, except on Oneida lake.

"That a canal boat, 104 feet long, 16 feet wide, drawing 7 feet water, would carry 200 tons, and require a lock 115 feet long by 17 feet wide; sectional area of boat below load water line 108 feet. The gross load of a schooner, with its own weight, would be 350 tons. Canal boats, constructed with reference to freight merely, will generally weigh in the ratio of their cargo as 4 to 9.

"The power required for traction will be in proportion to their transverse section, provided they hold equal similar ratios to the transverse section of the canal, or if the canal which is assumed in both cases to be equal to an unlimited expanse of water. The ratio of schooner to canal is as 1 to 3.94; the ratio of canal boat to canal as 1 to 5.48. The relative power of traction (deduced from the formula of Du Buat,) for equal sections, will be as 100 to 125. The ratios of the sections of the boat and schooner as 100 to 138; and we have, therefore, the ratio required for the boat and schooner as 100 to 167½, or the schooner will require (67 per cent.) two-third more power to tow her than for the boat. The cost of schooner 200 tons is $8,000, and the canal boat $2,800 for the same tonnage; ratio 100 to 285. In view of all the circumstances that affect the cost of transportation, we have come to the conclusion that the cost of transportation by the proposed canal, with schooners, would be 75 per cent., with canal boats constructed for this size of canal.

"The calculation for traction has been made with reference to the vessels moving at the same rate of speed, from which we conclude that the schooners would gain one day between Albany and Oswego; cost of transportation 66 cents greater per ton than by towing boats, and required double the lockage water."

Reports Fixing the Size of the Enlargement of the Erie Canal.

1st, *By John B. Jervis, Jan.* 26, 1835,

Who, agreeably to the request of Wm. C. Bouck, Canal Commissioner, reported upon the comparative economy of transportation on the Erie canal, with an enlarged section. The following table, requiring much calculation, embraces the result of Mr. Jervis' report. The Erie canal is made unit:

No. Plan.	DIMENSIONS.						Area boat (ratio) to canal.	Loss by rake of bow and stern.	Burthen exc'l of boat (tons.)	Tractile power required.	Size of lock chamber.	Rel. cost.	
	Canal.			Boat.									
	At bottom.	At surface.	Depth.	Width.	Draught.	Length.						Navigating boat.	Transp'n (per ton.)
1................	28	40	4	$13\frac{1}{2}$	$2\frac{1}{2}$	78	1:4.03	16	43.56	1.00	90×15	1.00	1.00
2................	28	40	4	$13\frac{1}{2}$	$2\frac{1}{2}$	88	1:4.03	16	50.62	1.00	100×15	1.00	0.86
3................	30	50	5	$13\frac{1}{2}$	3	88	1:4.84	16	61.88	1.07	100×15	1.02	0.71
4................	36	60	6	$13\frac{1}{2}$	$3\frac{3}{4}$	93	1:5.68	16	79.11	1.18	105×15	1.19	0.65
5................	42	70	7	$13\frac{1}{2}$	$4\frac{1}{4}$	98	1:6.83	16	98.01	1.20	110×15	1.25	0.55
6................	48	80	8	14	5	103	1:7.06	17	129.89	1.53	115×16	1.51	0.50
7................	36	60	[illegible]	$13\frac{1}{2}$	$3\frac{3}{4}$	98	1:5.68	16	86.48	1.18	100×15	1.19	0.60
8................	42	70	7	$13\frac{1}{2}$	$4\frac{1}{4}$	103	1:6.83	16	103.98	1.20	115×15	1.25	0.52
9................	48	80	8	$14\frac{1}{2}$	5	108	1:7.06	17	137.45	1.53	120×16	1.51	0.47

"When increased traction is to be provided for, the basis of calculation is taken at $\frac{1}{3}$ the total cost of navigating the boat. On this principle, the canal should be enlarged 40 per cent. to afford the most favorable navigation for present largest size boats and load; which, reduced to the capacity of the caral for lightest traction, would be $30\frac{90}{100}$ instead of $43\frac{56}{100}$ as given in the table. The same principle in No. 2 will produce $35\frac{94}{100}$ instead of $50\frac{62}{100}$; No. 3, $49\frac{1}{2}$ instead of $61\frac{88}{100}$; No. 4, $71\frac{2}{10}$ instead of $79\frac{11}{100}$. The reason I did not take any case below No. 5 was, that it was the first that afforded the most economical traction; and appeared as low as, in my judgment, should be adopted. It was estimated that $1\frac{1}{2}$ million dollars were paid last year for transportation. No. 5 would save one-half this."

2d, By Holmes Hutchinson, Jan. 26, 1835.

"In the improvement of the Erie canal, it will be desirable to reduce the traction of towing of boats.

"Experiments by Du Buat have shown, that the cross section of the canal ought to be $6\frac{46}{100}$ times the cross section of the boat. and width of canal at surface $4\frac{1}{2}$ times the width of the boat. The largest boats on the Erie canal are 14 feet wide and 3 feet draught. For such boats to move with the greatest advantage, the canal should be 63 feet wide, $5\frac{11}{100}$ feet deep, and have a cross section=$271\frac{32}{100}$ sq. feet.

"For an enlarged boat 4 feet draught, and cross section equal to 56 feet, the channel should be 63 feet wide, $6\frac{8}{10}$ feet deep, and have a cross section of $361\frac{3}{4}$ feet. The resistance in a fluid of

indefinite extent being 1, would give to the present Erie canal boats of the largest class a resistance of $1\frac{59}{100}$ or 59 per cent. more than in a fluid of indefinite extent. Towing is $\frac{1}{8}$ of the freight, or 14 cents per mile, or $8\frac{47}{100}$ cents for 100 lbs. from Albany to Buffalo.

3d, By Nathan S. Roberts, Jan. 17, 1835,

He was asked how much must the Erie canal be enlarged to reduce the expense of transportation, independent of tolls 30, 50 and 75 per cent. He replied that "the experiments of Du Buat determined that to attain this result, the cross section of the canal ought to be with moderate velocity $6\frac{46}{100}$ times the cross section of the boat, and the width of the canal at water line $4\frac{1}{2}$ times the breadth of the boat." "A canal 60 feet water line, 45 feet bottom, and 5 feet depth, will very nearly give these results; thus $13\frac{1}{2}\times4\frac{1}{2}=60.75$ for the water line and sec. of boat $13\frac{1}{2}\times3=40.5$, and section of canal $\frac{60 \quad 45}{2}\times5=262.5$. This calculation goes to show that the present locks of 15 feet width, are sufficient for a canal 60 feet wide." "The present canal admits boats $13\frac{1}{2}$ feet wide, 3 feet draught, 80 feet long, displaces 80 tons water, weight of boat 30 to 35 tons, cargo 45 tons. Size of canal, 28 feet bottom, 40 feet surface, 4 feet depth, cross sec.=136 sq. feet. Enlarged canal to reduce cost transportation, $43\frac{3}{4}$ per cent. must be 33 feet bottom, 48 feet top, and 5 feet deep, cross-sec.=202.5; width and size of locks, 15x110 between gates, admitting a boat 102 feet long, $13\frac{1}{2}$ feet wide, and 4 feet draught." The dimensions proposed by Mr. Roberts for the enlarged canal were 48 feet at surface, 30 feet at bottom and 6 feet deep, with locks 110x15, admitting boats of 100 to 120 tons burthen. The United States engineers calculated the size of a boat for 120 tons—len. on deck 100 feet, whole length 106 feet, beam 20 feet, depth of hold $7\frac{1}{2}$ feet, draught 5 feet. The following statement was submitted, showing the increase of business on the Erie canal:

REMARKS.	Number of Boats arrived, and departed from Albany.	Number of Lockages, Alexander's lock.	Year.	Navigable miles.	Tolls collected on the Erie canal.
Middle section completed October, 1819	------	------	1820	94	$5,437 34
			1821	94	23,000 00
			1822	116	57,160 39
			1823	160	105,037 35
	8,760	6,166	1824	280	294,509 47
Canal finished Oct. 26	13,110	10,985	1825	333	492,664 23
Uninterrupted navigation, Buffalo to Albany	------	15,156	1826	363	677,466 75
	------	13,004	1827	do	775,919 22
	23,662	14,579	1828	do	727,650 20
Failure in wheat crop	21,490	12,619	1829	do	707,883 49
	23,874	14,674	1830	do	943,545 35
Rates toll 35 pr. ct. greater than 1834	26,882	16,284	1831	do	1,091,714 26
	25,826	18,601	1832	do	1,085,612 28
Rates toll reduced 20 p. ct.	31,460	20,649	1833	do	1,290,136 20
Tates toll reduced 25 per ct. on merchandise, and 10 per ct. on produce	32,438	22,911	1834	do	1,179,744 97

4th. By Messrs. Jervis and Mills, in relation to Size of Enlarged Canal, October 23, 1835.

"That to accommodate the growing trade, without delays, and afford a cheap inter-communication, the expense will be increased less than ⅓ the ratio of the enlarged dimensions; we are of opinion that an 8 feet canal, by 80 wide, (except at the most expensive places, which may be 60 feet wide,) is the most suitable for the enlargement of the Erie canal."

5th. By Messrs. Roberts, Jervis, Hutchinson and Mills, on Walling and Docking the enlarged canal, Oct. 23*d*, 1835.

"Where wall is adopted, it is proposed to construct it as follows, viz.: The wall to be commenced from 2 to 3 feet below top water line, and extend to 1 foot above; the wall to have a slope from 1 to 1 to 1½ to 1, and be 15 inches thick at right

angles to its face; the face of the wall, at top water line, to be in position to give the proper width of canal at this point. The slope of the wall being less than the bank, will form a berm of 2 to 3 feet broad, projecting into the canal in front of the foundation of the wall. To guard the back side of the wall against the action of waves and frost, put heavy gravel behind it."

Report on Drainage, (Chenango Canal Reservoirs,)

By John B. Jervis, 1835.

(Review of former Report while Chief Engineer on Chenango canal, December 29, 1834.)

The following useful tables, results of Mr. Jervis' examinations, are taken from this exceedingly valuable report, with his comments thereon. We believe this to be the first and only examination of this subject in this country. The facts were obtained from actual observations and measurements.

EATON BROOK VALLEY.

1835. MONTHS.	Rain gauge.	Falling water on an area of 6,800 acres.	Amount of same passing sluice from same area.	Per centage of drainage to fall.
June	6,72	165,876,480	59,407,394	0.358
July	2.74	67,634,160	27,994,240	0.414
August	2.86	70,596,240	13,547,058	0.192
September	1.34	33,076,560	9,586,513	0.290
October	3.00	74,052,000	20,694,651	0.272
November	2.20	54,304,800	23,772,620	0.438
*December	0.96	23,696,640	36,525,544	1.541
June to December inclusive	....	489,236,880	191,528,020	0.392
June to October inclusive	....	411,235,440	131,229,856	0.319

* Drained the snow of November.

MADISON BROOK VALLEY.—No. 2.

1835. MONTHS.	Rain gauge, inches.	Falling water on an area of 6,000 acres — cubic feet.	Amount of same passing sluice from same area —cubic feet.	Per centage of drainage to fall.
*Snow on ground which fell in November and December of 1834.	....	87,120,000	....	
January	2.17	47,262,600	23,192,079	0.491
February	2.50	54,450,000	35,377,594	0.649
†March	1.03	22,443,400	43,284,656	1.928
†April	5.00	108,900,000	80,776,974	0.741
†May	1.98	43,124,400	58,013,176	1.345
‡June	8.05	175,329,000	20,138,006	0.115
‡July	3.87	84,288,600	23,141,302	0.274
‡August	3.06	66,646,800	23,725,060	0.356
‡September	0.88	19,166,400	19,158,957	0.999
‡October	3.86	84,070,800	19,544,880	0.232
‡November	2.10	45,738,000	18,232,372	0.399
‡December	0.76	16,552,800	19,401,364	1.172
	35.26			
Jan. to Dec. inclusive, and snow	....	855,092,800	383,986,420	0.449
January to May	....	363,300,400	240,644,479	0.662
June to October, inclusive	....	429,501,600	105,708,205	0.246

* Shows the snow on the ground when gauging commenced.
† With melting snow.
‡ Drainage equalized by reservoir.

"From table No. 1 the average drainage is $\frac{2}{5}$ of the falling water, June to October included $\frac{1}{3}$, August $\frac{1}{5}$, July $\frac{2}{5}$ the fall.

"From table No. 2 the average drainage for the year was $\frac{1}{2}$ the fall, January to May included $\frac{2}{3}$, June to October included $\frac{1}{4}$ the fall. The above is not only important in relation to the Chenango canal, but highly valuable to the public. The undersigned is not aware of any previous measurements having been made in this country for determining this question."

Enlargement of the Erie Canal.

Construction Law, passed May 11th, 1835.

The Canal Commissioners were authorized, under this law, to enlarge the Erie canal, construct double locks thereon as soon as they should deem it for the public interest; the dimensions of the canals and locks to be fixed by the Canal Board. The cost of construction to be paid by the Commissioners of the Canal Fund, including completion and maintenance out of moneys which might be on hand, belonging to the Erie and Champlain.

The Commissioners divided the enlargement into four sections, assigning to each a chief engineer, as follows:

No. 1.—Albany to East end Rome summit, to John B. Jervis.

No. 2.—East end Rome summit to Jordan, to Holmes Hutchinson.
do 3.—Jordan to Rochester, to Frederick C. Mills.
do 4.—Rochester to Buffalo, to Nathan S. Roberts.

A new survey and estimate, on two plans, were directed by the Canal Commissioners, one for a canal 6 feet by 60, and the other for one 7 feet by 70; the computations to be completed by Oct. 20. The following is a summary of such estimate, on sections 1, 2, 3, and 4.

First Estimated Cost of Enlargement of the Erie Canal.

No. of Sec.	By whom made.	Dimensions of Prism. 60 × 6 feet.	70 × 7 feet.
1.	October 15, 1835, John B. Jervis,	$2,389,205 13	$2,864,335 96
2.	do 21, do Nathan S. Roberts,	986,530 55	1,194,804 74
3.	do 19, do Fred. C. Mills,	2,276,297 40	2,739,139 51
4.	do 20, do Holmes Hutchinson,	4,028,031 29	4,518,575 85
	Total,	$9,680,064 37	$11,316,856 06
	The above, with 10 per cent added by the Canal Commissioners,	$10,548,070 40	$12,448,541 60

(Mr. Jervis was assisted by Wm. J. McAlpine, and Mr. Mills by Henry S. Dexter.)

Extracts from the Engineers' Reports accompanying the foregoing Estimate.

1st. By John B. Jervis.

That the trunks of acqueducts to be made fifty feet wide, with spans between piers of eighteen feet, the locks between quoins to be 110 feet long, and 16 feet wide, placed 40 feet apart from center to center; for a 7 feet depth canal. He estimated that for favorable traction, the old canal was adapted to a boat of 31 tons burthen, a 6 feet canal to one of 71 tons, and a 7 feet canal to one of 103 tons. Water to supply canals of different dimensions.

No. 1. *Erie Canal.*—Depth 4 feet, width on bottom 28 feet, top 40 feet, slopes $1\frac{1}{2}$ to 1 each side. Filtration is as the square of the depth, the areas being the same. Hence the square root of 4 is 2 for bottom; and the square root of 2 is 1.41 for slopes. Length of both slopes 14.42 feet, which is inversely as the square root of depth on bottom, to the square root of depth on slopes, to wit: 2 : 14.42 : : 1.41 : 10.16, the width of bottom, that would discharge a quantity equal to that discharged from the slopes. The whole width for comparison will be 28+10.16=38.16, say 38.

No. 2.—Depth 6 feet, width on bottom 36 feet, at top 60 feet,

slopes 2 to 1 each side. $\sqrt{6}=2.45$ for bottom. $\sqrt{3}=1.73$ for slopes. Length of slopes 26.82 feet, then 2.45 : 26.82 : : 1.73 : 18.93 feet. 36+18.93=say 55 feet the width bottom.

No. 3.—Depth 7 feet, width on bottom 42 feet, at top 70 feet, slopes 2 to 1, then; $\sqrt{7}=2.64$ for bottom. $\sqrt{3\frac{1}{2}}=1.87$ for slopes. Length slopes 31.30, then 2.64 : 31.30 : : 1.87 : 22.18 ft. +42= 64 feet the width on bottom.

Comparison of No. 1 *with No.* 2.—The discharge for the same area will be $\sqrt{4} : \sqrt{6} :: 100 : 122.50$. The result for No. 1 is 38, and for No. 2,55, and as 38 : 122.5 : : 55 : 177, or No. 2 will require for leakage 77 per cent more than No. 1. (The loss on the old Erie was assumed at 100 c. feet per minute per mile.

The comparison of No. 3 with No. 1, by the same method, will require 122 per cent more than No. 1. It may safely be assumed that No. 3 will require an addition of 80 per cent over the leakage from the old canal or No. 1. The ratio of evaporation will be (less in shallow than deep water) the same as required for leakage.

Lockage water required for an 8 feet lift, assuming boats to be full loaded, will, for No. 1, be equal to 348 c. feet per min., for No. 2, 177, and for No. 3, 128 cubic feet per minute, or a 7 feet canal will require thirty-seven per cent more water than the old canal.

2d. *By N. S. Roberts.*

That the size of locks be 110 feet between quoins, and 17 feet wide (assuming the width of the canal to be 4½ that of the boat, which would be 15½ feet). Considering that the resistance to a boat passing through water is much greater in proportion to its width than depth, 6½ feet are preferable to 4½ or 5 feet draught.

Scale of Prices.

For face stone, headers, stretchers, coping, and quoins, as follows: quarrying, 16½ cubic feet, $1.50; cutting on each perch, 5½ feet at 25 cents, $1.37½; cartage, $1.43; lime and sand, 50 cents; laying into work, and attendance, $1.62½; total cost of each perch face stone laid, $6.43.

Backing as follows: quarrying, $1¼; dressing, 30 cts.; cartage, $1.43; sand and lime, 50 cents; laying, $1.62; total, $5.10. The plans of bridges similar to Mr. Hitchcock's model.

3d. Fred. C. Mills.

The plans of bridges for 70 feet canal were modifications of the lattice principle of Ithiel Town. Locks estimated as by Mr. Jervis. In relation to supply of water, he computed the drainage area of Fish creek at 340 acres, furnishing 14,300 cubic feet per minute, and estimated the cost of making it a feeder to be $34,742. Skaneateles Lake reservoir was estimated to furnish 12,100 cubic feet per minute if raised 5 feet. Gauges were made of the natural flow, "one just above the sink holes above Hiram Earll's, at 6,300 cubic feet per minute, and the other below Cole's, at 4,958 cubic feet, making a loss in two miles of 1341.67 cubic feet. Wm. Jerome stated the loss in 1832 at 50 per cent; mine are 27 per cent." He estimated that the old Erie required 13,755 cubic feet per minute, 21,644 for 6 feet canal, and 25,147 for 7 feet canal, for 85 miles.

4th. By Holmes Hutchinson.

He gave a very complete specification of the manner of constructing double enlarged locks, the basis for the specifications subsequently used in the construction. He advised the construction of the Town's lattice bridge. Upon Du Buat's formula (sec. of boat to canal as 1 : $6\frac{46}{100}$, and breadth of canal $4\frac{1}{2}$ the boat, making movement of boat as in an indefinite space of water,) he presented the following statement. Size of present canal 28 and 40 by 4; locks, 90 by 15; length of boat, 80 by 14 wide, $2\frac{3}{4}$ draught; burthen, exclusive of boat, $38\frac{85}{100}$ tons. For enlarged canal size, 42 and 70 by 7; locks, 115 by 17; length of boats, 103 feet, 16 wide, 5 feet draught, tonnage 169 tons, exclusive of boat; cost of transportation one-half the old size, or as 0.54 to 1.

ROCHESTER AQUEDUCT.

Messrs. Jervis, Roberts, and Hutchinson, submitted a report, Nov. 23d, 1835, on enlargement and rebuilding this aqueduct. They adopted the plan of using stone throughout, and fixed the width of waterway at 40 feet, and the depth at 7 feet, with slopes 2 inches to 1 foot on each side. They estimated the cost at $141,074, and for stone piers and wooden trunk at $59,148. (This work was let March 8th, 1836.)

Dimensions of Enlarged Canal Fixed.

The Canal Board, after a careful examination of the plans and estimates presented, decided on making the enlarged canal 70 feet wide at surface, and 7 feet deep; locks 110 feet between

quoins, and 18 feet wide. The Board estimated that these proportions would save 50 per cent. in cost of transportation exclusive of tolls.

Cost of Champlain Canal, by Wm. Jerome, up to 1832, *inclusive.*

In answer to a Senate resolution, asking for the amount of expenditures on this canal, the Canal Board replied that it was difficult to obtain it, as the accounts had been kept with the Erie. They stated, however, that in a book on construction, kept by Wm. Jerome, engineer, they had found an accurate account of all the contracts, labor, and services, from commencement of the canal to the close of 1832. The total cost at that time from Whitehall to south end Cohoes dam, including lock and dam at Troy, ($92,595.) was

Troy, ($92,595.) was	$921,011 13
Interest on money borrowed from 1818 to 1823	92,101 11
Making total cost of canal	$1,013,112 24
Repairs, and interest on debt, in excess of tolls, 1823 to 1836	539,295 78
Total expenditure above receipts	$1,552,408 02

Progress of the Canals in 1836.

Enlargement of the locks on the Cayuga and Seneca canal authorized May 25th, 1836.

Construction Black River canal authorized April 19th, 1836, with an appropriation of $800,000, and Porteous R. Root was appointed chief engineer in June.

Chenango canal completed October, 1836, and cost $2,271,110, (including $245,605 paid for damages and allowances on contracts.) This exceeds the estimated cost at contract prices in 1835 of $48,683.

First work was let on the enlargement in August, 1836, and comprised 16 set double locks, 3 to 18, inclusive, with 4½ miles canal adjoining; 1 double and 2 single locks; 1 aqueduct,; 1 section at Syracuse; sections Nos. 85, 86, 19 to 25, and 10. Total estimated cost at contract prices of all work under contract in 1836 was $3,035,087.

Auction and Salt Duties.

In 1817, and until 1836, the auction and salt duties were transferred from the Common to the Canal Fund, paying $5,647,497 to the latter fund.

Improvement of Glens Falls feeder, authorized May 25th, 1836, as per report by H. Hutchinson.

Fish creek feeder was surveyed and estimate reported upon by Messrs. Jervis and Hutchinson. It was computed to furnish in the dry season 13,725 cubic feet per minute, and to cost $158,482.

Genesee Valley canal, construction authorized May 6, 1836.

Cost of completed and estimated cost of unfinished canals, as reported by the Canal Board, January 31st, 1837, in answer to an Assembly resolution.

CANAL.	Length canal.	Length feeders.	No. of locks.	Feet of lockage.	Estimated cost.	Actual cost.
Erie canal	362	8	84	689	$5,000,000 00	$7,143,789 86
Champlain canal	64					920,517 23
G. Falls feeder	....	15	38	339½	1,000,000 00	244,492 02
Dam and lock at Troy	....	3			at cont. prices.	92,595 01
Oswego canal	38	....	14	123	437,000 00	565,437 35
Cayuga and Seneca canal	21	2	11	80	153,871 88	236,804 74
Chemung canal and feeder	23	16	53	516	331,125 20	331,693 57
Crooked Lake canal	8	....	27	269	119,198 00	156,776 90
Chenango canal	97	....	116	1,021	1,960,456 28	2,270,605 22
	613	44	343	3,037½	$9,001,651 36	$11,962,711 90
UNFINISHED CANALS.						
Black River	35	11	135	1,083	$1,068,437 20	
Genesee Valley	107	15	132	1,057	2,002,285 92	
	142	26	267	2,140	$3,070,723 12	

Allowed to claimants not included in above.

To claimants for damages on the Oswego canal, up to September 30, 1836	$3,525 00
To claimants for damages on the Cayuga and Seneca canal, up to September 30, 1836	4,545 00
To claimants for damages on the Chenango canal, up to September 30, 1836	32,845 00
Total	$40,915 00
Total revenues received from canals by Commissioners of Canal Fund from 1817	$27,097,683 00
Total paid on account of canals by Commissioners of Canal Fund from 1817	23,031,329 00
Surplus	$4,066,353 00
Total receipts from tolls (included in above,) from 1817 to 1836 inclusive	$12,489,220 00

PROGRESS OF THE CANALS IN 1837.

Total cost Chenango canal, up to January 1st, 1838, including necessary repairs, (previous to appointment of superintendents,) for maps, surveys, and allowances by Canal Board on contracts for damages, $2,316,186.29. This includes all the feeders and reservoirs.

Black River Canal.

Estimated cost, at contract prices, by P. R. Root, Chief Engineer, January 3, 1838, Rome to High Falls	$1,881,420 00
Improvement of river, High Falls to Carthage, locks and dams	98,817 00
Feeders	230,397 00
Total cost estimated at contract prices	$2,431,699 00

Number of structures on all the canals, January 1st, 1838.

640 miles canal; 394 stone locks, 72 stone aqueducts, 163 stone waste weirs, 377 stone culverts, 5 stone weigh locks, 1 241 wooden bridges, 57 repairing scows, 10 ice breakers, 7 under-water excavators, 216 State buildings, 28,144 lineal feet dams, 235 miles slope wall, 186 miles docking, 7 piling machines.

Work on Enlargement.

January 1st, 1838, there were 51 locks not under contract—23 between Albany and Utica, 6 between Utica and Seneca river, 12 between Seneca river and Rochester, and 5 double set combined at Lockport. The locks under contract were 25 double and 10 single, as follows: 21 double and 3 single between Albany and Schenectady, 1 double and 3 single at Little Falls, 2 double and 1 single at Syracuse, 1 single at Lyons, 2 single at Lockville, 1 double and 1 single at Macedon. Total amount of work under contract, at contract prices, Jan. 1st, 1838, $3,035,087.

Reduction and Comparison of Tolls.

The rates of tolls for 1837 were $39\frac{3}{10}$ per cent. lower than in 1832; while those of the Pennsylvania State canals and railroads for the same year were $53\frac{8}{10}$ per cent. higher than on our canals.

Total receipts of Commissioners Canal Fund from 1817 to 1837 inclusive	$28,517,782 00
Total paid by Commissioners Canal Fund from 1817 to 1837, inclusive	25,292,482 00
Surplus	$3,225,300 00

Scientific report of O. W. Childs.

On survey of overflow of lands on the Oswego canal, under

act, May 12, 1837, Mr. Childs submitted an able and scientific report, January 24, 1838. He was assisted by John Lathrop, Resident Engineer. The following are extracts from the report:

DISTANCES AND ELEVATIONS TAKEN Aug. 7, 1837, OSWEGO & SENECA RIVERS.

No. of stations 3 chains apart.	PLACE.	Distance from dam at Phœnix, miles.	Elevation of low water above canal bottom, feet.	ELEVATION OF	
				Ordinary high water above canal bottom	High water, spring 1836, above canal bottom.
0	Dam at Phœnix	....	4.50	7.20	9.58
7	Head of Three river rapid	0.21	4.55	....	....
19	Station No. 19	0.57	4.73	....	....
24	Foot of Knock-em-stiff	0.72	4.79	....	....
25	Head of do	0.75	4.81	....	....
31	Below Enos' point	1.13	4.83	....	....
34	Above do	1.22	4.88	....	....
43	Head Drury bar	1.49	4.98	....	....
60	Three river point	2.20	5.07	....	13.5[illegible]
74	Fort Gascon rapid	2.62	5.07	11.32	13.63
83	Near Center rapid	3.09	5.54	11.39	....
86	Station 86, or 258 chains from Phœnix	3.18	5.87	11.62	....
90	Station 90	3.30	6.09	11.83	14.18
94	Head Gascon Rapid	3.42	6.22	12.22	14.23
100	Station 100	3.60	6.40	12.40	....
115	Belgium	4.25	6.61	12.61	15.45
241	Cold Spring	9.03	6.67	....	....
254	Mud lock	9.42	6.77	13.27	16.26
	Numbered from Mud lock.				
58	Station No. 58	11.56	6.81	....	....
77	do No. 77	12.33	6.93	....	....
114	do No. 114	13.64	7.04	....	....
145	Foot of lock, Baldwinsville	14.77	7.04	13.54	17.24
157	Foot of dam, do	15.33	9.50	16.00	17.60
157	Above dam, do	....	16.64	....	....

Calculations were made by Mr. Childs to determine the effect by the Phœnix dam, at low water and with flash boards on, at the head of Gascon rapids.

"Using Eytelwein's formula $a\,v+b\,v^2=RI$, (a and b constant quantities determined by experiment,) $a=0.0000242651$ and $b=0.0001114155$. These substituted for a and b and equation reduced gives $v=-0.1088941604+\sqrt{0.0118580490+8975.414285\ RI}$.

"In order to express more fully the relation between the area (w,) quantity (Q,) perimeter (x,) and fall, divided by the length (I,) a further reduction gives $0.0000242651\,Q\,w+0.0001114155\,Q^2=\frac{w^3}{x}I$.

"In the following table the velocity of river is calculated from foregoing formula, also the inclination necessary to pass the quantity of water which is actually in canal or side cut, with the surface velocity as observed.

SEPTEMBER, 1837.

No. STATION.	Calculated inclination necessary to pass the water now passing in canal.	Calculated necessary inclination in river and canal.	Actual inclination in canal.	Observed surface velocity in canal.	Mean velocity in canal.	Calculated mean velocity in river outside of canal.	Mean velocity of river and canal.	Area of canal.	Area of river.	Area canal and river.	Perimeter of canal.	Perimeter of river.	Perimeter of canal and river.	Mean radius of canal.	Mean radius of river.	Mean radius of canal and river.	Quantity per second.	
																	In canal and river compounded.	Do. calculated separate.
88	.014454	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......
87	.023166	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......
86	.034056	.040	.07	3.15	2.55	1.90	2.05	2.57	8.09	1066	56.00	362	418	4.59	2.23	2.55	2,185	2,192
85	.040986	.040	.09	3.44	2.81	1.95	2.00	2.57	8.23	1080	56.50	343	400	4.55	2.40	2.70	2,160	2,327
84	.051480	.050	.11	3.76	3.07	2.15	2.30	2.43	7.03	946	55.00	315	365	4.42	2.23	2.60	2,175	2,257
83	.065280	.062	.13	4.31	3.55	2.20	2.45	2.48	5.41	789	56.00	286	342	4.43	1.90	2.31	1,993	2,070
82	.075834	.076	.15	4.55	3.77	2.30	2.65	2.62	4.69	731	59 00	278	337	4.44	1.70	2.17	1,937	2,066

"By placing flash boards on the Phœnix dam previous to commencing survey, and from observations upon the rise of water at the pegs, the results were as follows:

SENECA RIVER.

	Feet.
At the dam	0.83
At Three River point	0.59
Foot Gascon rapid	0.50
Head do	0.00

ONEIDA RIVER.

At Peter Scott's creek	0.37
At Richard's bar	0.37
¾ mile below Oak Orchard	0.29
Oak Orchard	0.10

The quantity passing Oswego river averaged 3,184 cubic feet per second, as gauged at "Knock-em-stiff."

PROGRESS OF THE CANALS IN 1838.

Enlargement of the Erie.

The total estimated cost of work under contract, at contract prices, was $10,405,913 January 1st, 1839, total paid for work completed, $11.606,093 including damages. The Commissioners of the Canal Fund were authorized by Act, April 18th, 1838, to borrow four millions.

The location for the enlargement, from Frankfort to Oriskany, was settled in 1836, and the work through Utica put under contract. The canal three miles east of Genesee St. bridge, Utica, together with the weigh lock, were put under contract September 26, 1838. 62 miles of enlargement, with all the locks and aqueducts between Albany and Utica, (not previously let,) also double lock No. 50, and one set double and single locks at Syracuse, were put under contract Nov. 17, 1838. The Jordan level, with Nine Mile Creek feeder, was put under contract October 3d, with mechanical structures. O. W. Childs was chosen to estimate upon and locate the enlargement (direct line) from Brighton to Fairport. The Commissioners decided to follow the old canal $5\frac{14}{100}$ miles longer, but saving in the estimate $965,783.

The enlargement of the Genesee river feeder was completed. The Rochester aqueduct nearly completed. Five sets of combined locks, and ½ mile canal in Rochester, and 2½ miles at Mountain Ridge, were put under contract in October.

Chemung Canal.

Fifty-two wooden locks upon the Chemung canal, built from plans by Holmes Hutchinson, all required rebuilding, so cheap and imperfect were the original plans, having been in use only six years, and costing $1,650 each.

Black River Canal.

The canal and structures, from Lansing Kill to near High Falls on the Black River canal, was let during the year. The improvement of Black River was commenced by jettees, piers, &c. The whole amount of work under contract, at contract prices, was $1,564,834.

Genesee Valley Canal.

The Genesee Valley canal, from Rochester to the Rapids, was completed during the summer, and 23 miles contracted for to Dansville. The whole amount of work under contract, at contract prices, was $4,900,122, April 6th, 1839.

Tolls.

The total amount of tolls received on all the canals, from 1820 to 1838, inclusive, $16,780,727.66.

Scientific Report of O. W. Childs, on Improvement of Oneida River, (under Act, April 18, 1838,) *Jan.* 15, 1839.

He estimated the cost of improvement for steamboat navigation at $100,049. Van R. Richmond, resident engineer, performed the field work.

Mr. Childs in obtaining the proper size of the channel at the outlet of Oneida Lake, and the velocity for easy navigation, used the following method of calculation.

The length of bar 528 feet, fall in stream $1\frac{10}{100}$, base of channel $6\frac{60}{100}$ feet below surface of lake. Velocity not observed, but calculated from Eytelwein's formula, viz.: $.0000242651v+.000111415\ v^2=RI$. v=mean velocity, R mean radius, or area divided by perimeter, and I the fall divided by the length. This gave a mean velocity of 2.95 feet per second, and surface velocity 3.60 feet. The quantity of water passing $=309.54\times2.95$ $=913.10$ c. feet per sec. The perimeter was increased $33\frac{1}{3}$ per cent for passing over rocky bottom, which made the quantity =990 c. ft. per sec. To provide for contingencies, 1,000 c. feet

were assumed to pass in a cut 1,188 feet long, with sides sloping 3 to 1, and a fall (after completion of the cut) of 2 inches; the width of cut at bottom being to the depth as 16 to 1. In determining the dimensions and velocity of cut, the formula of Eytelwein was used, viz.: $0.0000242651Qw+0.0001114155Q^2=\frac{w^3}{\lambda}I$ $w=$ area, $X=$perimeter, I inclination, W=width at bottom, d=depth water in cut, n=ratio slope of sides to their height. Then $w=d(W+nd)$, and $X=W+2d\sqrt{1+n^2}$. As $W=16d$, and $n=3$, we have $w=19d^2$ and $x=22.324h$. Substituting these in the equation, it becomes $0.0000242651\times1000\times19d^2\times0.0001114155\text{-}\times1000^2=\frac{19^3d^6}{22.324h}\times0.0001347$. The value of d satisfying this equation is 4.947 : $W=16d=79.152$, and $w=19d^2=464.98$ and $v=\frac{Q}{w}=\frac{1000}{464.98}=2.15$ mean velocity=2.70 at surface, and lowering the lake 15 inches.

Champlain Canal and Glens Falls Feeder.

The widening of this feeder, as stated by the Canal Commissioners, cost $137,108.

Enlargement of the Cayuga and Seneca and Oswego Canals.

The Canal Board reported in favor of this enlargement, April 11th, 1839.

Total Payments and Receipts on each Canal, by Commissioners Canal Fund, from April 15th, 1817, to Sept. 30th, 1838.

Canals.	Total Receipts.	Total Payments.
Erie and Champlain	$31,065,057 58	$27,412,803 93
Oswego canal	1,064,720 59	1,064,720 59
Cayuga and Seneca canal	500,030 67	500,030 67
Chemung canal	569,764 26	569,764 26
Crooked Lake canal	204,462 30	204,462 30
Chenango canal	2,770,034 02	2,733,232 81
Black River canal	624,901 94	134,619 17
Genesee Valley canal	2,092,227 07	351,680 12
Totals	$38,891,198 43	$32,971,313 85

Progress of the Canals in 1839.

2d, *Estimated Cost of the Enlargement of the Erie Canal, March 25, 1839. By O. W. Childs, Nathan S. Roberts, Holmes Hutchinson, Alfred Barrett, and Isaac W. Crane, Chief Engineers.*

Amount at contract and engineers' prices, $23,402,863.23, including damages and all other expenses, with 7 per cent. for

engineering and superintendence. The Canal Commissioners reported the same to the Legislature, in compliance with an Assembly resolution.

Black River Canal.

Four public lettings were held for this canal, viz: Nov. 1, 1837; May 2, 1838; September 3, 1839, and December 4, 1839. Total expended in construction up to January 1, 1840, $761,604. Total estimated cost at contract prices, as reported in 1838, $2,431.699.

Genesce Valley Canal.

Three public lettings were held for this canal; 1st, in 1837; 2d, in 1838; 3d, in 1839. Total payments for construction up to January 1, 1839, $1,474,273. Total estimated cost at contract prices in 1839, by Fred. C. Mills, $4,900,122, including the reservoirs, $197,099. Length main line, 107 miles; 116 locks, 1,056 $\frac{83}{100}$ feet lockage.

Seneca River Towing Path.

Its construction was authorized April 18, 1838. The work was completed Oct. 15, 1839, from Mud lock to Baldwinsville, 5$\frac{1}{3}$ miles, at a cost of $14,864.

Oneida River Improvement.

Its construction was authorized April 29, 1839; the work was put under contract, and awarded to Garrett C. Sweet, Oct. 1, 1839. The estimated cost, at contract prices, by O. W. Childs was $71,793, adding 12 per cent. for engineering and contingencies. The depth of water in all the cuts to be 4$\frac{1}{2}$ feet, width at outlet 80 feet, and all the others 30 to 60 feet wide, with slopes 2 and 3 to 1. The lock chambers to be 120 feet long by 30 feet wide, battered $\frac{1}{2}$ inch to the foot.

Enlargement Work.

Rochester aqueduct, estimated cost, at contract prices, $422,245, and weigh lock connected, $34,683. Total amount of work done up to January, 1840, $322,751.

Lockport locks, estimated cost, at contract prices, $558,468, including short section at foot, $35,000. There were 5 pairs combined 55$\frac{2}{3}$ feet lockage. The work was put under contract October, 1838. The old locks were constructed in 1823, 1824, 1825, and cost $123,309, exclusive of excavation.

Black River Canal Extension.

Was surveyed by Ed. H Broadhead, chief engineer, under act May 3d, 1839. He transmitted his report Feb. 21st, 1840. The principal assistant engineers were John S. Stoddard, of Geneva, and Squire Whipple, of Utica. The termination was at French creek, on the St. Lawrence; and the estimated cost, with stone locks, $1,345,269.

Genesee Valley Canal.

The following scientific report of W. H. Talcott, resident engineer, is inserted in full for its useful calculations on the supply of water, embracing all the experiments and results bearing on this subject:

Report of W. H. Talcott, Resident Engineer on the Fourth Division of the Genesee Valley Canal.

I. *General Description.*

The fourth division of the Genesee Valley canal is $31\frac{86}{100}$ miles long, divided into 32 sections, numbered 76 to 107, inclusive. It commences on the Genesee river, in the town of Caneadea—continues up the valley of this river about 4 miles, then up Black creek valley to the summit swamp, thence down the valleys of Oil and Olean creeks, to the Allegany river at Olean.

The length of the summit level is $11\frac{67}{100}$ miles.

On this division there are 35 locks, (numbered 72 to 106, inclusive,) with the following lifts, to wit:

1	of	12	feet lift.
12	of	11	do
5	of	10	do
8	of	9	do
9	of	8	do

Making a total amount of 338 feet lockage. Of this amount, 26 locks, with an aggregate lift of 252 feet, are on the north side of the summit level, and 9 locks, amounting to 86 feet lift, on the south side.

The other mechanical structures, exclusive of reservoirs, are:

1 guard lock,
1 Genesee river feeder dam,
6 double track bridges,
22 single do
25 farm bridges,
1 arch culvert, 30 feet span,
4 do 20 do

2 arch culverts,		8 feet span.	
2	do	6	do
9	do	4	do
17	do	3	do

15 rectangular culverts, 2½ feet span,

10 waste weirs,

2 wooden trunk aqueducts, with stone abutments and piers, one over Caneadea creek, which has 8 spaces, each 22 feet long and 10 feet high, and the other over Olean creek, near Olean, with 5 spaces 30 feet long and 14⅓ feet high.

At Rockville, on section 82, Black creek descends rapidly for a distance of 20 chains through a defile barely wide enough for the site of the canal, bounded on either side by precipitous hills of shale and sandstone.

This difficult pass is to be overcome by constructing a small reservoir, (by means of a dam at the head of the defile,) from which the waters of the creek will be discharged through 4 chains of artificial channel into a ravine, leading to the valley below the defile, and the canal made to occupy the old creek channel. The valley is also narrow and very circuitous, for a distance of 2 miles above this point, making it necessary to change the creek channel repeatedly, and in several instances to cut through projecting points of hills, composed in part of cemented clay and gravel.

A marsh, called the "summit swamp," divides the waters which flow into the Genesee river from those which flow into the Allegany river.

The deepest cutting in this marsh is 12 feet, most of which is muck, and for about one mile will probably have to be excavated wide enough to construct gravel banks within the excavation.

In several places on the summit level, particularly on sections 95, 96, and 97, the line is located on a steep, winding side hill, as is also about one mile of the Ischua feeder.

With these exceptions the valleys are generally wide, and the line presents about the usual variety of excavation and embankment found on works of this kind.

Two reservoirs are proposed, besides the small one at Rockville, for supplying the summit level with water, to wit: one on Oil creek, half a mile from the canal, with a dam 55 feet high, 600 feet long, and 285 wide on the bottom, and 1,056 feet long and 10 feet wide on top; also a wing dam 1,300 feet long and about 20 feet high. The greatest depth of water is 45 feet.

This reservoir will cover about 490 acres, and contain 390 millions cubic feet of water.

The other reservoir is on Ischua creek, 2¾ miles from the canal, The dam is 70 feet high, 900 feet long, and 360 feet wide on the bottom, and 1,600 feet long and 10 feet wide on top. The greatest depth of water is 60 feet, and the reservoir will cover about 575 acres, and contain 588 millions cubic feet of water.

Oil creek reservoir will receive the drainage of 16,827 acres, as ascertained by survey. The drainage into Ischua creek reservoir has not yet been measured, but as near as can be computed from Burr's county maps, it will flow from 67,734 acres.

II. *Present state of the work on the Division.*

Eleven sections of canal, ta wit—numbers 76 to 86 inclusive, extending from the north end of the division to the north end of the summit level, were located previous to October 22d, 1838, and an estimate of the cost of the same prepared, which, with the incidentals, and ten per cent. for contingencies, amounted to $695,362.17.

On the 31st day of Oct., 1838, proposals were received at the letting at Mount Morris for this part of the division, at which time all the sections, 12 locks, the bridges on three sections, and the Caneadea creek aqueduct were let. The estimated cost of the work let, including incidentals, and 10 per cent. for contingencies, amounted to

gencies, amounted to	$378,896 89
The cost of the same at contract prices, including incidentals and contingencies, amounted to	383,554 56
Excess of contract over estimate prices	$4,657 67

After the letting in October, 1838, a preliminary survey was made of several lines from the north end of the summit level to Hinsdale, including the Ischua feeder. An estimate of the cost of the same, prepared therefrom, was submitted on the 10th of December following. The line called the South line was adopted, the estimate cost of which, including incidentals, and 10 per cent. for contingencies, amounted to $304,409.65.

An estimate of the cost of the canal from Hinsdale to Olean was also prepared, by Mr. H. P. Mills, in December, 1838, from preliminary surveys made in 1837, the amount of which, including incidentals, and 12 per cent. for contingencies, was $231,576.99.

These estimates, which embraced all the work on the division except the reservoirs, and the Genesee river feeder dam, are as follows:

Eleven sections north of the summit level, including mechanical structures	$695,362 17
From the north end of the summit to Hinsdale, including mechanical structures	304,409 65
From Hinsdale to Olean, including mechanical structures	231,576 99
Total	$1,231,348 81

It has been stated that eleven miles of canal were let in 1838. The remaining part of the line has been let during the present season, and proposals for the same, and for all the mechanical work on the other eleven miles, which was not let in 1838, were received at this office on the 9th day of October last. The whole amount of work offered at the letting was estimated to cost, including incidentals, and ten per cent. for contingencies, $684,146 42

The cost of the same at the prices at which it was allotted, including incidentals and contingencies, amounts to	573,017 68
Excess of estimate over prices at which the work was allotted	$111,128 74

The estimate cost of what has been taken, and for which contracts have been or will soon be executed, amounts to the sum of $531,139.26, leaving a balance not taken equal to $153,007.16.

The estimates of 1838 were made for stone locks, stone bridge abutments, and a navigable Ischua feeder, and embraced all the work on the division, except the reservoirs and the Genesee river feeder dam. Those herewith submitted are for composite locks, wood bents in lieu of stone abutments, for all except the double-track bridges, (and one farm bridge let in 1838,) and an unnavigable Ischua feeder.

By adding the Genesee River feeder dam to the estimate of last year, the two may be compared as follows:

Total amount of the estimates submitted in 1838, is	$1,231,348 81
Add Genesee River feeder dam	11,847 41
	$1,243,196 22
Total amount of the present estimate for the same, is,	1,035,358 48
Excess of the estimates of 1838 over those of 1839, is	$207,837 74

caused principally by the above mentioned change in the plan of construction.

The estimate cost of constructing the proposed reservoirs (exclusive of land and damages) is, for

Rockville reservoir	$9,409 29
Oil creek do	115,216 49
Ischua creek do	231,614 48
Total	$356,240 26

The relative value of each reservoir in feeding the canal in a year, when the fall of rain is only a minimum, may be seen by the following estimate of the amount of water which each will furnish during the time of navigation:

	Cubic feet.
Rockville reservoir	98,994,233
Oil creek do	310,881,843
Ischua creek do	1,215,666,484
Total	1,625,542,560

On the first of January, 1839, only three contracts had been commenced on the division. Now, the work is progressing on all the contracts entered into in 1838, and on 22 contracts taken in October last.

The work done on the whole division at this time, amounts to the sum of $59,318.71.

III. *Supply of Water for the Summit Level.*

In your report to the Canal Commissioners, dated Feb. 17th, 1835, the amount of water required on the summit level is stated at 3,484 cubic feet per minute, and it was then proposed to supply this amount from streams and reservoirs, as follows:

From Ischua creek, cubic feet per minute	1,122
Lime lake do	258
Fish lake do	311.64
Beaver and Mud lakes, do	244.80
Black creek do	33.56
Oil creek do	36
Little Oil and Swamp creeks	38
Total	2,044
Deduct loss by filtration and evaporation, in conducting said waters on to summit	488
Leaving for feeding canal	1,556

In addition to the above, seven reservoirs were proposed, to wit: four natural ponds or lakes, which were to furnish for 140 days	667.7
And three artificial reservoirs, which would furnish, for the same time, the following amounts, viz:	
Ishua creek reservoir	792.2
Lower Oil creek do	284.2
Upper do do	620.2
Total	3,620.3

The minimum flow of water in all these streams was considerably less last year, than at the time you measured them in 1834, as may be seen by the following statement of gauges taken in September, 1838.

Ischua creek, cubic feet per minute		812
Lime lake,	do	197
Fish do	do	136
Beaver and Mud lakes,	do	123
Black creek,	do	29
Oil creek,	do	81
Little Oil and Swamp creeks		0
Total in 1838, is		1,378
Total in 1834, is		2,044
Difference		666

The lakes mentioned above, are situated about 20 miles north of the canal, and discharge their waters into Cattaraugus creek. To divert these waters from their natural channel, will seriously affect the machinery erected at the outlet of the lakes, and also for a great distance down the creek. It may be well, therefore, to see whether an adequate supply can be obtained, without resorting to these lakes.

In any case, nearly all the water for the summit supply must first be collected in reservoirs, and then drawn out as required for feeding the canal. The question may therefore be most properly treated, as one where the whole supply is dependent on reservoirs. It will be convenient to divide the subject into

First—The Demand.

Second—The Supply.

First—The Demand.

It is obvious that the amount of water required must be sufficient:

1. *To fill the canal.*

2. *To supply the loss by evaporation and filtration from the canal.*

3. *To supply the loss by leakage and waste at the mechanical structures.*

4. *For lockage water for the trade of the canal.*

5. *To supply the loss by evaporation, filtration and otherwise, from the reservoirs.*

1. *Amount required to fill the canal.*

This will be its cubic contents, augmented by the amount of evaporation, filtration and leakage at the mechanical structures, during the time of filling. But the simple contents of the canal will be sufficient for this item, providing the filtration, leakage, &c., of canal is computed from the time the water is first let into it.

2. *Evaporation and filtration from the canal.*

The loss from these sources, (though entirely distinct, and referable to widely different causes,) is usually considered as one item. This arises partly from the fact that in most cases, particularly in this country, one bears but a small ratio to the other, and partly from the difficulty of determining the relative proportions of each, though the whole amount may easily be measured in any given case.

Direct observation alone will determine the true amount of this item, which must always depend very much upon the construction of the canal. The Chenango canal, in this State, is fed in part by means of artificial reservoirs—and more care was taken in the construction of the part thus fed, to guard against loss of water by filtration, than on any other canal in the State. If we assume that the construction of the Genesee Valley canal will be as good in this respect as the Chenango, then a very close estimate of the loss under this head may be made, by determining the amount required on the Chenango canal.

You are aware that in August last, Messrs. H. Tracy and S. Talcott were sent from this office with instructions to make whatever measurements might be necessary to determine the amount of evaporation and filtration on the Chenango canal, and the

leakage at the mechanical structures; also to collect such other information relative to the supply of water on that canal as would be useful in determining the amount required on the summit level of the Genesee Valley canal.

They proceeded immediately to Binghamton, and thence along the canal to the summit level, and for the purpose of measuring the evaporation and filtration, selected, on the 31st of August, a portion of the canal, (fed from the reservoirs,) extending from the north end of the summit level to the Erie canal, a distance of 22 miles. The water for feeding it is drawn through 2 gates, each 4 feet wide, raised, one 6 and the other $5\frac{1}{2}$ inches, with a head of $3\frac{1}{3}$ feet above the bottom of the aperture. This gives a total discharge of 2,117 cubic feet per minute, to which should be added the leakage of the lock situated at the north end of the summit level, which was 226 feet per minute, with a head or lift of 9.4 feet.

They next passed along the line of the canal over the whole distance, (22 miles,) noting the leakage and waste at the several waste weirs and aqueducts, which was found to be in all,

Leakage, 220 cubic feet per minute,
Waste, 204 do do

and the leakage of the last, or junction lock, was 479 cubic feet per minute.

By bringing these items together, we see that the total amount of water received into the canal at foot of lock No. 76, expressed in cubic feet, per minute, is

in cubic feet, per minute, is		2,343
Leakage at waste weirs and aqueducts	220	
Waste do do	204	
Leakage at lock No. 1	479	
		903
	leaving	1,440

cubic feet for the evaporation and filtration on 22 miles—equal to $65\frac{48}{100}$ cubic feet per minute per mile.

3. *Leakage at the mechanical structures.*

This includes the leakage at the locks, waste weirs and aqueducts.

1. *Locks.*—It is obvious that the locks which leak the most are those which govern this question. Also that the amount of leakage is materially affected by the lift of the lock.

The lifts of those locks which are to determine the amount of

this item, on the Genesee Valley canal, are equivalent to 11 feet each.

We have already seen that lock No. 1 on the Chenango canal leaked 479 cubic feet per minute, with a lift of $5\frac{1}{2}$ feet. This amount very much exceeds the leakage of any other lock which was gauged on the canal, although the lift is the least of any. The disparity is so great as to induce the belief that the gates were not properly closed at the time of the measurement.

At lock No. 69, (where the leakage was more than at any other except No. 1,) the amount was 382 cubic feet per minute, with 8 feet lift. If we consider the leakage to be as the square root of the lift, or head, and take 382 feet for 8 feet lift, the amount for 11 feet lift will be 447 cubic feet per minute.

The locks on the Genesee Valley canal are to be composite, very similar to those on the Chenango canal, in every respect except the valve gates, of which there is to be twice as many.

A considerable amount of the leakage is at the valve gates. We are therefore of opinion that it would be unsafe to estimate this item at less than 500 cubic feet per minute, for each end of the summit level, or 1,000 for the whole.

2. *Waste weirs.*—We have already seen that this item is quite too considerable to be omitted in this inquiry.

The average at the 8 waste weirs on the Chenango canal, referred to above, is 20 cubic feet per minute, and the greatest amount at any one is 30 feet. It should be borne in mind that the structures on the Chenango canal are comparatively new. On this account they present a minimum, rather than a mean, of what may be relied upon for a series of years. The average waste over each weir was 12 cubic feet per minute. It is believed the amount of leakage may be somewhat reduced by adopting a different plan from the one used on the Chenango canal, and that 30 cubic feet per minute will provide for leakage and waste.

3. *Aqueducts.*—The greatest amount observed on the Chenango canal was 20 cubic feet per minute, for a trunk 56 feet long, equal to $\frac{35}{100}$ of a cubic foot, for each lineal foot of trunk.

As the general plan of construction is very similar in both cases, this amount may be considered sufficient for our purpose, providing the sides of the trunk are made high enough to prevent any waste over the top.

4. *Lockage water for the trade of the canal.*

This item is naturally resolved into the amount of the trade of the canal, and the number of locks full of water required for each boat.

Under the most favorable circumstances, that is to say, when boats going in opposite directions meet at the point most favorable for passing the summit level with the least water, one lock full is required for each boat, and two locks full is the greatest amount ever required for one boat. Considering the irregularities of trade, and other things which are found in practic to affect this item unfavorably, we are of opinion that nothing less than the maximum amount can be considered a safe estimate.

It is evident that the amount of water which can be commanded in a case of this kind, should be abundant for the trade at the opening of the canal, and for any possible future increase, although it may not be necessary to provide so great an amount at first.

It is difficult to arrive at any satisfactory estimate of the future trade on the works of this kind—after all, such estimates must of necessity be in a great degree conjectural. In this case, much must depend upon whether this canal is to be connected to any useful extent with the Ohio river; without such connection, the trade can never be very extensive—but with it, the canal will become a successful competitor for a large amount of western trade, particularly that part which now goes by way of the Pennsylvania canals and railroads. Then again—in case of any interruption of the lake navigation—nearly, or quite all, which now passes through the Erie canal will be turned through this channel.

The number of lockages at the Black-Rock dam guard-lock on the Erie canal in 1836, amounted to 13,032, equal to the passage of $53\frac{41}{100}$, say 54 boats per day.

If we assume that the trade on this canal will never exceed in any one year, the amount which passed Black-Rock in 1836—then 54 boats, or 108 lockages per day will be sufficient for this item.

5. *Loss from the Reservoirs.*

It does not appear that any observations have been made in this country, by which the amount of this item can be very accurately ascertained. It may naturally be subdivided into the amount due,

1. *To evaporation.*
2. *To filtration and absorption.*
3. *To leakage at the fixtures for drawing water.*

But we have not sufficient data to analyze this question satisfactorily. The observations on this subject seem to have been made with reference only to the entire loss,—and it has been usual to refer the measure of that loss, to the surface of the reservoir.

Mr. J. J. Abert, in "a report to T. W. Veazey, Governor of the State of Maryland, in reference to a canal to connect the Chesapeake and Ohio canal with the city of Baltimore," dated December 10th, 1838, quotes from Sutcliff as follows: "In the summer months, they (meaning the reservoirs of the Rochdale canal) sink one inch per day, when the cocks are shut close, and yet I think no reservoirs are more water-tight than they. But I will only estimate upon the reservoirs wasting half an inch per day, and confine it to those on Blackstonedge, as that at Hollingswork gives a certain quantity of water constantly to the mill owners, which makes it difficult to ascertain how much it wastes."

Mr. Abert also states, that "for the same object Andreossie applies to the reservoirs of the Languedoc canal 12 millemetres per day, equivalent to 0.472 of an inch. These rates, says he, "are given by both authors, as actual states of loss from exposed surfaces, under the effect of rain upon them." He also adopts in his report half an inch per day, during the whole year for this item—nevertheless, this rule cannot be of universal application; for the evaporation only is uniform over the whole water surface, while the character of the soil and the depth of water in the reservoir, must necessarily affect the amount of filtration and lockage—and besides, the loss from evaporation is much greater in summer than in winter.

Although we have not the requisite data for analyzing the *whole* subject, we still think that a separation into, *loss by evapo-*

ration, and *loss from all other sources*, will facilitate this inquiry, particularly in its application to parts of the year.

1. *Loss from Reservoirs by evaporation.*

Various experiments have been made on the evaporation of water from small exposed surfaces—and much ingenuity displayed in the construction of hygrometrical instruments, and in other efforts to determine the absolute quantity of moisture in the atmosphere, and its capacity to drink up water at different temperatures, and in different states of weather; but we have sought in vain for something directly applicable to this subject.

Mr. Abert has collected many interesting facts on the evaporation of water, from experiments made in England and France, from which he has deduced a ratio between the evaporation of the laboratory, and that which exists on a canal; which ratio, he says, "will be found to be as 1 to 1.44." However this may be, in regard to canals, we think it cannot apply to large water surfaces, where the depth is considerable, as in the case of a reservoir. It certainly cannot be applicable to the whole water surface on the globe; for this would make the amount of evaporation very much greater than the falling water.

Mr. Abert states, that "Mr. Sullivan, in his report upon the Chesapeake and Ohio canal, gives the annual evaporation at Salem (Mass.) at 56 inches; and the Board of Engineers, in their report upon the Morris canal, in 1823, state that Mr. S. Williams had ascertained the evaporation at Cambridge (Mass.) to amount annually to 56 inches.

We shall introduce here a table of observations on the evaporation of water, by Hoyle and Dalton of England; also another by James Coffin, Esq., of Ogdensburgh, N. Y.

I.—TABLE

Of the mean monthly evaporation from water surface, and from the surface of the ground, during the years 1796, 1797 *and* 1798. *By Hoyle & Dalton. To which is affixed the average daily evaporation deduced from the monthly.*

[From the Edinburgh Encyclopedia.]

MONTHS.	EVAPORATION FROM THE SURFACE OF			
	WATER.		GROUND.	
	Monthly inches.	Daily inches.	Monthly inches.	Daily inches.
January	1.50	0.0484	1.01	0.0326
February	2.00	0.0714	53	0.0189
March	3.50	0.1129	62	0.0200
April	4.50	0.1500	1.49	0.0496
May	4.96	0.1600	2.69	0.0868
June	6.49	0.2163	2.18	0.0726
July	5.63	0.1816	4.09	0.1319
August	6.06	0.1955	3.38	0.1090
September	3.90	0.1300	2.95	0.0983
October	2.35	0.0758	2.67	0.0861
November	2.04	0.0680	2.05	0.0683
December	1.50	0.0484	1.48	0.0477
Amount	44.43		25.14	

II.—TABLE

Of the montnly evaporation from the surface of water at Ogdensburgh, N. Y., in 1838, *by James Coffin, Esq., Principal of the Ogdensburgh Academy. To which is affixed the average daily evaporation for each month, deduced from the monthly. Also the monthly temperature and rain.*

[From the Report of the Regents of the University of N. Y. for 1838.]

MONTHS.	EVAPORATION.		Inches of rain and snow.	Degrees of temperature.
	Monthly inches.	Daily inches.		
January	1.625	0.0533	2.36	24.75
February	817	0.0292	97	12.33
March	2.067	0.0667	1.18	32.94
April	1.625	0.0542	40	39.81
May	7.100	0.2290	4.81	52.54
June	6.745	0.2248	3.57	66.53
July	7.788	0.2512	1.88	71.66
August	5.415	0.1745	2.55	68.31
September	7.400	0.2466	1.01	59.22
October	3.948	0.1273	2.73	44.58
November	3.659	0.1220	2.07	29.74
December	1.146	0.0370	1.08	19.43
Amount	49.362		24.61	

If these rates of evaporation can be safely applied to a reservoir, (and the danger, if any, is that they are too high,) then the locality of Ogdensburgh entitles the experiments of Mr. Coffin to the preference in their application to this examination.

2. *Loss from reservoirs by filtration, absorption and leakage.*

We have stated above the observations of Sutcliff and Andreossie, which fix the total loss, from all sources, at about half an inch per day, from the surface of the water in the reservoir. This is certainly, at best, but a very indefinite term; and yet, for want of something more definite, we are compelled to adopt it in preference to relying on mere conjecture.

By this rule the total loss will be $182\frac{50}{100}$ inches per annum, from which deduct the loss by evaporation, (49.36 inches,) and there remains for this item $133\frac{14}{100}$ inches, which is equal to 0.3647 of an inch per day.

SECOND—THE SUPPLY.

The questions to be considered under this head, are:

1. *What is the annual fall of rain?*
2. *How much of the falling water can be collected in a reservoir?*

1. *How much water falls in a year?*

The annual reports of the Regents of the University of this State contain rain tables, kept in obedience to their instructions, at sundry academies in more than 40 different localities in this State. These tables, which give the monthly fall during each year, afford data for solving this question.

The general average fall, for 13 years, to wit: from 1826 to 1838, inclusive, as far as reported, amounts to $36\frac{24}{100}$ inches.

If all the reservoirs could be made of such capacity as would secure the entire drainage of each valley during a year of greatest fall, we might, with considerable propriety, adopt the average fall of the whole State. This, however, can be done in only one of the three valleys, from which the supply for the summit is to be obtained; and even in this one case, provision for a year in which the fall equals this general average, is as great as will combine economy and utility in the construction of the reservoirs.

It will, therefore, in almost every instance, be necessary to obtain a year's supply from what falls, from the close of navigation in one year to the close of navigation in the next year. This being the case, it will readily be perceived that the least annual

fall of rain is that upon which our calculations for a supply ought to be based.

The only difficulty lies in deciding upon a locality the most applicable to the place under consideration. An attentive examination of the Regents' reports shows that, exclusive of Long Island, the fall is greatest in the most elevated parts of the State. The valleys from which drainage, in this case, is to be obtained, are from 1,600 to 2,000 feet above tide water.

Hartwick, in Otsego county, is 1,100 feet above tide water, and in many respects appears to be as applicable as any selection that can be made. At this place the average fall for 10 years is 38.44 inches, but in 1837 the amount was only 28.25 inches.

It is well known that a large amount of the annual rain in this country falls in showers, whose track is frequently narrow; thus causing a considerable range in the annual amount of falling water, even in contiguous districts. This renders it impossible to determine the amount of fall upon any considerable territory, by observations confined to one place.

In adopting a rate of rain equal to the fall at Hartwick in 1837, we would remark, that it is less than the fall at other contiguous places during the same year. The monthly fall is as follows:

January	1837	'20	inches.
February,	"	1.62	"
March,	"	1.85	"
April,	"	2.36	"
May,	"	4.33	"
June,	"	3.51	"
July,	"	2.80	"
August,	"	2.94	"
September,	"	88	"
October,	"	3.68	"
November,	"	1.84	"
December,	"	2.35	"
Total		28.36	inches.

2. *How much of the falling water can be collected in a reservoir?*

We commence this inquiry by quoting from a report, "on the ratio between drainage and the fall of rain and snow, in the district supplying the Chenango canal, by John B. Jervis, Esq., civil engineer, dated January 14th, 1836," as follows:

"On Madison brook and on Eaton brook, gauge sluices have been put in, and the water gauged daily at each, during the whole time, exhibited in the following tables."

"A rain gauge was established at Eaton brook, and the quantity of falling water carefully recorded; at Madison brook the rain gauge kept at the Hamilton academy has been furnished for this purpose."

"The country descending to the sluice, in each case, has been measured, and the results from the tables afford correct data to determine the question of drainage."

TABLE No. 1.—EATON BROOK VALLEY.

1835. MONTHS.	Rain gauge. Inches.	Falling water on an area of 6,800 acres. Cubic feet.	Amount of same passing sluice from same area. Cubic feet.	Perc'tage of drainage to fall
June	6.72	165,876,480	59,407,394	0.358
July	2.74	67,634,160	27,994,240	0.414
August	2.86	70,596,240	13,547,058	0.192
September	1.34	33,076,560	9,586,513	0.290
October	3.00	74,052,000	20,694,651	0.272
November	2.20	54,304,800	23,772,620	0.438
December*	0.96	23,696,640	36,525,544	1.541
June to December inclusive	....	489,236,880	191,528,020	0.392
June to October inclusive	....	411,235,440	131,229,856	0.319

* Drained the snow of November.

TABLE No. 2.—MADISON BROOK VALLEY.

1835. MONTHS.	Rain gauge. Inches.	Falling water on an area of 6,000 acres. Cubic feet.	Amount of same passing sluice from same area. Cubic feet.	Perc'tage of drainage to fall
*Snow on ground which fell in November and December of 1834	....	87,120,000	....	....
January	2.17	47,262,600	23,192,079	0.491
February	2.50	54,450,000	35,377,594	0.649
†March	1.03	22,443,400	43,284,656	1.928
†April	5.00	108,900,000	80,776,974	0.741
†May	1.98	43,124,400	58,013,176	1.345
‡June	8.05	175,329,000	20,138,006	0.115
‡July	3.87	84,288,600	23,141,302	0.274
‡August	3.06	66,646,800	23,725,060	0.356
‡September	0.88	19,166,400	19,158,957	0.999
‡October	3.86	84,070,800	19,544,880	0.232
‡November	2.10	45,738,000	18,232,372	0.399
‡December	0.76	16,552,800	19,401,364	1.172
Jan. to Dec. inclusive and snow	35.26	855,092,800	383,986,420	0.449
January to May inclusive	....	363,300,400	240,644,479	0.662
June to October inclusive	....	429,501,600	105,708,205	0.246

* Shows the quantity of water furnished by the snow on the ground when the gauging commenced. † With melting snow. ‡ Drainage equalized by reservoirs.

"From table No. 1, it appears the average drainage from June to December inclusive, (7 months,) was 0.392 of the falling water, or nearly $\frac{2}{5}$, and the average from June to October inclusive, (5 months,) was 0.319, or nearly $\frac{1}{3}$ of the fall. August is the minimum month, and shows a drainage of 0.192, or nearly $\frac{1}{5}$ of the fall. July is the maximum month, (except December, which drained the snow of November,) and a drainage of 0.414, or over $\frac{2}{5}$ of the falling water."

"From table No. 2, it appears the average drainage for the year 1835, including the snow on the ground the 1st of January, was 0.449, or nearly half of the falling water. January to May, inclusive, (5 months,) 0.662, or say $\frac{2}{3}$ of the fall. June to October inclusive, (5 months,) 0.246, or say $\frac{1}{4}$ of the fall. It will be observed the quantity drained from June to October inclusive, was very uniform, although the falling water is very different, which causes a great range in the ratios for the several months. This was produced by the reservoir on Madison brook, which retained the flood waters, and discharged them nearly uniform through the reservoir pipes, causing the highest ratio to appear in the month of the least fall, and the smallest ratio in the month of the greatest fall of water. It is therefore obvious that an average of June to October, (5 months,) will be required, to give a proper view of the drainage during the season of the greatest evaporation,"

"From June to October, the Eaton brook valley gave a drainage of 0.319, and Madison brook valley 0.246 of the falling water. This result, it is believed, has been produced by the different characters of the two districts drained. The Eaton brook valley is, in itself, very narrow, and the grounds that drain into it are generally quite steep, and the soil is mostly of a very close texture. The Madison brook valley is much wider, the slopes of the adjoining lands that drain into it are more easy, and the soil in some parts is more porous than that on Eaton brook."

"The Eaton brook valley, I should think, would afford more than an average drainage over a large district of country, including the usual varieties of soil; and the Madison brook would probably not differ materially from the general average."

The tables show the fall and drainage which occur in each month. But these divisions, applied to the fall and drainage of water, do not appear natural, inasmuch as they do not give a correct ratio for parts of the year, because there may be a great fall in the last days of one month, the drainage of which will be

mostly in the succeeding month, thus giving too great a ratio of drainage to one month, and too small to the other, which would not be the case if the divisions had reference to the falling water instead of the months.

The ratio of drainage from June to October inclusive, appears to be,

On Eaton brook valley	0.319	of the fall.
On Madison "	0.246	"
Difference......	0.073,	

which is equal to about 30 per cent of the latter, and this too against the greatest fall, for the fall on Madison brook was 19.72 inches, and only 15.66 inches on Eaton brook.

This extraordinary difference is attributed to the "different character of the two districts drained." If such is the case, it is manifestly unsafe to apply either of these results to any other valley, unless it can be shown that there is an exact similarity between the two.

There are, however, some things tending to diminish this difference, which do not appear to have been considered in Mr. Jervis' report.

It is there stated, that Madison brook reservoir "retained the flood waters, and discharged them nearly uniform through the reservoir pipes." The gauge sluice was below the reservoir dam, so that the gauging indicated only what was discharged through the pipes each day, instead of what drained off from the valley.

From the table, it appears that the discharge from June to October inclusive, was nearly uniform, and amounted to about 20 millions cubic feet each month. To discharge this amount through the pipes of Madison brook reservoir, requires a head of about 30 feet, as ascertained by trial during the past season. With 45 feet depth of water, the surface area amounts to 235 acres. It may, then, reasonably be supposed, that 30 feet deep will cover at least 100 acres, and that therefore the drainage of this valley must have been exposed, during the whole time, to the waste of a reservoir of these dimensions.

The Canal Commissioners, in their report of 1835, say, in relation to waste from reservoirs, that "a particular examination of the banks of reservoirs No. 1 and 2, on Madison brook, has shown that the soil is much more porous than was anticipated, and more particularly No. 1." This indicates that the waste from filtration may have been very considerable, in addition to the evapo-

ration. If the waste on this account was equal to the rates we have adopted in this inquiry, the amount would be 30,666,240 cubic feet.

A considerable amount must also have been left in the reservoir, on the last day of October, for the discharge in November amounted to over 18 millions cubic feet, which would require a constant head of nearly 25 feet. If the water was even 20 feet deep at the end of October, the amount thus retained was probably 20 millions cubic feet. By adding these sums to the amount gauged, the ratio of drainage is swelled to 0.364 of the fall, which exceeds the ratio of Eaton brook valley; but the fall was greatest on Madison brook valley; hence a greater ratio of drainage might be expected.

If these corrections are applied to the drainage of Madison brook valley, during the whole year, the ratio will be 0.518 of the fall. It does not follow, however, because the ratio of drainage is 0.518 of the fall, where the fall equals 39.26 inches per annum, that it will be the same with any other rate of fall. Nor does it follow, either from the experiments quoted above, or from any we have ever seen, that there exists any constant ratio between the fall and drainage.

If we should inquire why the drainage does not equal the fall, the universal answer would be, that certain natural consumers of rain, such as evaporation, vegetable and animal life, filtration for the supply of the lower levels, &c., must first be supplied from the fall; and that therefore the drainage can only amount to what is left after these demands are supplied.

These demands are much more uniform than the falling water, and since they must be supplied first, it is evident that the drainage will depend altogether upon the excess of fall over what is required for their supply. The amount thus consumed, in this climate, is much greater in summer than in winter, the natural result of which is, a greater ratio of drainage from winter than from summer fall—an inference clearly sustained by Mr. Jervis' observations.

From observations taken during September, October, and November of the present year, it is ascertained that on Oil creek valley the amount of fall was 5.54 inches, and the
drainage, 1.17 "
leaving 4.37 " for the consumption from the valley.

Table No. 1 shows, that during the same months in 1835, the fall on Eaton brook valley amounted to 6.54 inches, and the drainage to .... 2.19 "

leaving .... 4.35 " for the consumption from the valley.

A comparison of Eaton and Madison brook valleys, by the tables, shows that the consumption from June to December inclusive, was

On Madison........................... 15.99 inches.
On Eaton........................... 12.05 "

If, however, the corrections, as stated above, on account of waste from the reservoir, are applied to Madison brook reservoir, the result is,

On Madison........................... 13.30 inches.
On Eaton........................... 12.05 "

We do not claim that these facts are sufficient to establish any general rule, although they seem to confirm the views herein taken of this question.

If the above reasoning is correct, it becomes necessary to determine the amount required for natural consumption, in order to know how much will drain off.

Hoyle and Dalton found the evaporation from the surface of the ground in England equal to 25.14 inches per annum. By table No. 2, it appears that the whole consumption on Madison brook valley was 21.63 inches; but allowing for waste from the reservoir, the amount is only 18.93 inches.

Mr. Jervis' observations show the entire consumption of the valley. For this reason, as well as on account of their contiguous locality, they are the most applicable to this inquiry.

There are objections to using the results obtained on Madison brook valley, from June to December. Nevertheless, if we adopt a rate of consumption equal to that deduced from the table, the error, (if any,) tends to exhibit the drainage below the amount which will be realized in practice.

In applying the foregoing results to the summit level of the Genesee Valley canal, we propose to assume a canal navigation from the 1st April to the 1st of December, equal to 244 days.

From the above reasoning we conclude that,

1st. The evaporation and filtration will amount to 66 cubic feet per minute per mile.

2d. The leakage at the mechanical structures will be, per minute, for the locks, 500 cubic feet at each end of the summit level; for leakage and waste at each waste weir, 30 cubic feet, or 210 feet for the whole, and 53 cubic feet for Olean creek aqueduct, making a total leakage and waste at the mechanical structures of 1,263 cubic feet per minute.

3d. We are to allow 2 locks full of water per boat for passing the summit, and 27 boats each way per day, equal to 1,194 cubic feet per minute.

4th. The loss from the reservoirs will be, by filtration, absorption and leakage, 0.3647 of an inch per day from the surface, and by evaporation, the same rate as that observed by James Coffin, Esq., of Ogdensburgh, in 1838.

5th. To adopt for the falling water the same per month as the fall at Hartwick, in 1837; to wit, 28.36 inches, and

6th. To allow 21.63 inches for the natural consumption of rain in the valley, which leaves 6.73 inches for the drainage.

Having settled the preliminary questions relating to the amount of water required for the canal, the fall of rain and of drainage, we are now prepared to apply these results to the case under consideration.

In the arrangement of reservoirs, three are proposed, as follows:

1st. *Rockville reservoir*, on Black creek, with a dam 20 feet high, a water surface of 72 acres, and containing 18,223,000 cubic feet of water. It will receive a drainage from 15,563 acres.

2d. *Ischua creek reservoir*, on Ischua creek. This location will admit of a dam 70 feet high, a water surface of 575 acres, and the reservoir will contain 588 millions cubic feet of water, and receive the drainage from 67,734 acres.

3d. Oil creek reservoir, on Oil creek, the dam to be 55 feet high, and the water surface 490 acres. It will contain 390 millions cubic feet of water, and receive the drainage from 16,827 acres.

The location of Rockville reservoir is such that, in any case it can only supply 4½ miles, including one waste-weir.

As the drainage into this reservoir, during either of the three first months of navigation, very much exceeds the amount required for the 4½ miles of canal, it may be assumed that on the first day of July it will be full, having supplied this part of the canal up to that time. The fall in July is 2.80 inches, which is

probably about the amount required for the natural consumption. There will, however, be considerable drainage during this month, for, in time of severe drought in September, 1838, this stream, at its lowest stage, afforded 29 cubic feet per minute.

As there has been no drought up to the 1st of July, it may reasonably be supposed that the drainage during this month will be at least one hundred cubic feet per minute, which will amount to

amount to	4,464,000	cubic ft.
In reservoir on 1st July	18,223,000	do
	22,687,000	do
Loss from the reservoir will be	2,770,416	do
Total amount available in July	19,916,584	do
Required to feed canal	14,597,280	do
In reservoir 1st August	5,319,304	do

The fall in August exceeds the consumption, but in September the consumption is more than the fall, and then again in October the fall is the greatest. In order to arrive at correct results of drainage for these months, it is necessary to embrace them all in one statement, because the consumption, in time of severe drought, is not supplied entirely from what is yet retained of the previous fall. It also reaches forward to the succeeding rain, by drawing out from the soil, and the surface of the ground, moisture which must be supplied again by absorption from the next fall of rain.

The fall in these three months is	7.50	inches.
And the consumption as we have apportioned it	7.10	
Leaving	0.40	of an inch

to drain into the reservoir during these three months.

The amount will be	22,597,476	cubic ft.
On the 1st of August there was in the reservoir	5,319,304	do
	27,916,780	
Loss from reservoir amounts to	3,099,200	do
Total amount available in August, September and October	24,817,580	do
Required to feed canal	43,329,960	do
Showing a deficiency of	18,503,380	do

which must be supplied from the other reservoirs.

The amount which will enter the reservoir in November, is	13,558,485	cubic ft
Loss from reservoir	531,432	do
Total amount available in November	13,027,053	do
Required to feed canal	14,126,400	do
Showing a deficiency for this month of	1,099,347	do
Bring down deficiency at end of October	18,503,380	do
If this statement is correct, then	19,602,727	do

of water must be drawn from the other reservoirs during the season of navigation to feed this portion of the canal. It might be shown that the difference in the leakage of the locks, above and below where the water from this reservoir is received into the canal, (on account of their different lifts,) would reduce this deficiency, and also that the drainings into the reservoir will be increased by the filtration of the canal. There are, however, so many contingencies connected with the whole subject, that it is thought best not to bring these amounts into the calculation.

The location and dimensions of the other reservoirs will admit of making one general statement for the whole year. The drain-

		Cubic feet.
age from the two valleys amounts to		2,065,816,773
Loss from reservoirs		282,760,018
Total amount available for feeding canal		1,783,056,755
The amount required for the canal is:		
For filling canal	19,388,160	
Evaporation and filtration	631,255,680	
Leakage at mechanical structures	436,777,920	
Lockage water	419,523,840	
Deficiency at Rockville reservoir	19,602,727	
		1,526,548,327
Surplus		256,508,428

which is about 15 per cent. of the total amount required for feeding the canal.

Respectfully your obedient servant,

WM. H. TALCOTT.

Cuba, Allegany Co., Dec. 31, 1839.

FREDERICK C. MILLS, Esq.,

Chief Engineer G. V. canal.

Value of real and personal property of this State, as reported by the Canal Committee, March 28th, 1840, was as follows: for the year 1815, $231,000,000; 1825, 263,000,000; 1835, $530,000,000; 1838, $627,000,000; 1839, $654,000,000; the increase being equal to 55 times the original cost of the Erie canal 14 years after its completion.

Total Expenditures for Repairs by Superintendents, from 1826 *to September* 30*th*, 1839.

Erie and Champlain canals	$4,071,116 24
Oswego canal	278,837 12
Cayuga and Seneca	150,201 59
Chemung canal	111,032 37
Crooked Lake canal	25,184 76
Chenango canal	57,566 11
Total	$4,693,938 19

Champlain canal and Glens Falls feeder: the work constructed under the law of 1836 was 12 stone locks, and enlargement of the feeder. The amount estimated to complete these improvements was $247,706.

Oswego canal, in 1840, contained 18 locks, 6 guard locks, stone, 8 dams, 32 bridges, 8 culverts, and 1 aqueduct.

Cayuga and Seneca canal: 12 locks, 4 waste weirs, 58 bridges, and 6 dams.

Chemung canal: Joseph D. Allen, chief engineer, submitted a report of the cost of enlarging, to the size of the Erie, the Chemung canal, from Havana to the lake, at $104,902, March 17th, 1841.

Progress of the Canals in 1840.

Enlargement of the Erie Canal.

The work under contract between Albany and Little Falls, including structures at contract prices, $6,730,825. The number of enlarged locks, 39, and on the old canal, 46, between these points. Estimated cost of work to be put under contract on this portion, $2,075,822. Sections 123 and 124 under construction. Lock No. 47 completed in May, and No. 48 in November, 1840. It was found that the old canal from Lockport to Brockport had a declivity of half an inch per mile, and from thence was level to Rochester. Total amount of work under contract, including all

damages, engineering, &c., $12,817,429; total amount paid on same Jan. 1st, 1841, $8,247,295.

Champlain Canal.

2 stone locks, 2 aqueducts, and slope wall on 5 miles, were built during the year. 2 stone locks were let Oct. 6. Of the 24 locks on this canal, 2 were rebuilt of stone in 1834-35-40, and 2 completed in 1842. 2 were rebuilt previous to 1832.

Progress of the Canals in 1841.

Enlargement of the Erie Canal.

Total amount of work under contract January 1st, 1842, $13,769,550, in detail as follows: 111 miles on the Eastern, 94 miles on the Middle, and 159 on the Western Division.

The number of locks on the old Erie canal was 83. Number located for the enlarged canal, 74, of which there were under contract:

36	double and	9	single, equal to	40½	double, on the	Eastern	division.
1	do	4	do	3	do	Middle	do
1	do	10	do	6	do	Western	do

The lower Mohawk aqueduct cost $315,071.

Supply of Water.

During the dry season, observations were made by O. W. Childs, of the supply and deficiency of water between Lodi and Little Falls, 82½ miles. Total supply from present feeders, 9,254 cubic feet per minute. The amount consumed at the extremities for lockage and leakage of locks, 2,440 cubic feet; for Oneida Lake canal and Utica weigh lock, 1,248 per minute; for filtration, the evaporation and loss at structures of 5,566 cubic feet, equal to 67½ cubic feet per minute per mile; 20¾ miles were enlarged, and 64¼ old canal.

Utica weigh lock completed and brought into use.

Oneida Lake Canal,

In pursuance of act May 11, 1840, chap. 258, was purchased by the Canal Commissioners, for $50,000, including feeder.

Enlargement across Cayuga Marshes.

The present location and plan (1862) of crossing the Cayuga marshes were determined upon by the Canal Commissioners and chief engineer in charge in 1840 and 1841. O. W. Childs was the chief, and Van R. Richmond resident engineer, whose plans

and recommendations for the higher level, were adopted by the Canal Commissioners.

Rooms in the new State Hall were assigned to the Canal Department by act May 25th, 1841.

Champlain Canal and Glens Falls Feeder.

An act to improve the same, and appropriating $75,000, passed April 19th, 1841.

Seneca River.

The act to reduce Onondaga lake to the level of Seneca river passed May 10th, 1841.

Cost of Enlargement Work in 1841, *at Contract Prices.*

1 mile enlarged canal,	(average of	57	contracts)	$37,550
1 set double locks,	do	27	do	76,273
1 aqueduct, small class,	do	6	do	32,530
1 do large do	do	3	do	234,376

Proposition by a Company to complete the Canals.

A petition, signed by Horace Birdsall, J. L. Curtin, George Mann, and T. Roberts, asked the Legislature to incorporate a company called "the Erie Canal enlargement and the Black river and Genesee Valley canal completion company," with a capital of $25,000,000, divided into shares of $100 each, for the purpose of raising funds, in addition to the canal tolls, for the completion of these canals within three years from January 1st, 1842. As stated by the petitioners, their proposition was to avoid the arresting of the prosecution of the aforesaid canals by the State, then indicated by the Legislature. The company, after the completion of said canals, was to provide for all deficiencies after the application of the tolls, to meet State stock created for that purpose, and pay the same up to the year 1860. The company to receive the tolls for five years thereafter, after all deductions of expense of collection.

Financial Condition of the Canals.

The gross amount of all the tolls received from all the canals up to Sept. 30, 1841 .... $21,130,529 00

Deducting expense of operating same, viz:

Payments to superintendents for repairs	$5,435,882 00	
Payments to collectors and inspectors	484,881 00	

Payments to weigh masters	$67,656 00	
Payments miscellaneous expenses	700,191 00	
		$6,688,612 00
Net proceeds of tolls from 1820 to 1841, inclusive		$14,441,917 00

Canal Debt.

The debts contracted for the construction of the following canals, Sept. 30, 1841, were for:

		Loans.	Annual interest.
Enlargement of the Erie canal		$6,941,119 00	$354,211 96
Oswego canal	at 5 pr. ct.	421,304 00	21,065 20
Cayuga and Seneca	do	237,000 00	11,850 00
Chemung canal	do	430,292 00	21,514 61
Crooked Lake canal	do	120,000 00	6,000 00
Chenango canal	do	2,402,535 00	120,326 78
Black River canal	do	1,076,706 00	53,835 31
Genesee Valley canal	do	2,556,379 00	127,818 99
Oneida Lake canal	do	50,000 00	2,500 00
Improvem't Oneida river	do	50,000 00	2,500 00
Original Erie and Champlain debt		2,021,037 00	211,300 00
Actual canal debt and interest		$16,306,374 00	$832,922 85

Of all the moneys received and paid, on account of all the canals, by the Commissioners of the Canal Fund, from 1817 to Sept. 30, 1841.

Total receipts from all sources	$55,565,506 00
Total payments	52,408,242 00
Surplus	$3,157,264 00
With a canal debt of	$16,306,374 00
And enlargement work under contract	13,769,550 00

***Reduction of Rates Toll since* 1825.**

Comptroller Flagg, in his report of 1839, stated that the rate of toll on merchandise had been reduced since 1825 from 30 mills to 9 mills, and on agricultural products from 15 to 4½ mills.

Commissioners Canal Fund stated in report, 1837, that the reductions in the rates of toll were equal to an average of 36 per cent. upon all products transported. Mr. Paige, from Committee of Finance, 1839, stated that a general reduction in the

rates of toll was made in 1833, and in that and the next year a reduction was made equal to about 36 per cent., as compared with former rates.

Anticipated Tolls on the Erie from 1826 *to* 1836, *by Canal Commissioners Van Rensselaer, Young, Seymour and Bouck in* 1825.

(In making this comparison, the Commissioners of the Canal Fund state in the report for 1842, that the accounts of the Erie and Champlain had never been kept separate until the fiscal year of 1841, and, in order to separate them, they used the relative per centage, as stated in the report of the Commissioners of the Canal Fund in 1840, viz: That the Erie canal contributed 84 per cent., and the Champlain canal 16 per cent. In 1841 it was 17 per cent.)

YEAR.	Inhabitants, estimated.	Tolls, estimated.	Actual receipts, after deducting expense of collection.	
			Erie canal, after deducting 16 per cent. for Champlain.	Champlain canal.
1826	1,000,000	$500,000 00	$707,017 35	$134,669 92
1827	1,100,000	550,000 00	739,451 22	140,847 68
1828	1,200,000	600,000 00	695,080 96	132,396 32
1829	1,300,000	650,000 00	670,149 89	127,647 52
1830	1,400,000	700,000 00	854,432 76	162,748 96
1831	1,500,000	750,000 00	997,196 76	189,942 24
1832	1,600,000	800,000 00	909,895 04	173,313 28
1833	1,700,000	850,000 00	1,133,579 09	215,919 68
1834	1,800,000	900,000 00	1,124,187 38	214,130 88
1835	1,900,000	950,000 00	1,201,659 22	228,887 36
1836	2,000,000	1,000,000 00	1,293,022 83	246,289 92

It will be seen, by the above table, that Col. Young and his associate Commissioners, had the gratification of seeing their prophetic estimates of 1825, more than realized, notwithstanding the great reduction in the rates of toll, upon which this estimate was founded.

They, also, estimated that the tolls on the Erie would amount to two million dollars in 1846, and four million dollars in 1856.

Legislative History of the Enlargement of the Erie Canal.

The necessity of the enlargement was first suggested in the annual report of the Canal Commissioners, dated March 4, 1825, attributed to the able pen of Samuel Young.

The attention of the Legislature was directed to the subject of the enlargement by Governor Marcy, in his annual message in 1834.

Canal Commissioners Van Rensselaer, Bouck, Young, Earll, and Hoffman, in speaking of the enlargement in their report of 1833, remark, "that the period had arrived when, in this enlightened policy, the locks of the Erie canal, east of Syracuse, should be doubled," and "the capacity of the canal to meet the wants of the transportation must be attained by extending the lock and enlarging the canal to admit boats of greater tonnage."

Governor Marcy again called the attention of the Legislature to the importance of this enlargement in his annual message of 1835.

That part of Governor Marcy's message relating to canals, was referred to the Assembly Canal Committee, of which Hon. Charles Humphrey was chairman, who reported a bill for improving the Erie, authorizing the Canal Commissioners to construct a second set of locks, of such dimensions as they should deem proper, from Albany to Syracuse, and adapt the canal to them, &c.

This bill was referred to a select committee, consisting of Mr. R. H. Morris of N. Y., Mr. Beardslee of Herkimer, and Mr. F. M. Haight; and being reported complete by Mr. Haight, passed the Assembly. Ayes 66, noes 34; and Senate—ayes 22, noes 1; Messrs. Edwards, Foster, Ganesvort, Hubbard, McDonald, Mack, Sudam, and others, being in the affirmative. The bill was approved by Governor Marcy, and became a law May 6, 1834.

On January 30, 1835, a special report was made to the Legislature, by Van Rensselaer, Hoffman, Young, Bouck, and Earll, Canal Commissioners, relative to the improvement of the Erie canal, in which they remarked that to secure the cheapening of transportation by reducing the rates of toll and expenditures, the enlargement would be delayed, and the business of the country so rapidly increasing, would seek other channels, and with the tolls be lost to the State.

This subject was referred to the Canal Committee, of which David Wager, of Oneida, was chairman, who reported in favor of the proposed enlargement. The following are extracts from this report: "The magnitude of the work, and the present crowd of business upon the canal, make it necessary to commence it without delay. By doubling the locks, and increasing

the capacity of the canal for boats of 120 tons burthen, the charges for transportation would be reduced more than 50 per cent., exclusive of tolls, which would give a reduction of over 25 per cent. in the aggregate expense, and the canal would be in a condition to accommodate more than four times the business. Mr. Wager thereupon reported a bill, which passed the Assembly —ayes 86, noes 16; and Senate by a unanimous vote, Colonel Young (who was then a member of the Senate) being among the number. The bill, being approved by Governor Marcy, became a law May 11, 1835. The Canal Board was authorized to determine the dimension of the canal and locks.

The Canal Board fixed these dimensions Oct. 20, 1835.

Governor Marcy, in his message to the Legislature in the session of 1836, remarked, that "the canal is to be made seven feet deep, and seventy feet wide on the surface."

The Canal Board made a special report to the Legislature, January 26, 1836, in which they remarked that the Board, after careful examinations of the information derived from the surveys and facts submitted to their consideration, decided that the canal should be enlarged to 7 feet depth, and 70 feet surface; and in the present month they agreed on a lock 110 feet long be tween quoins, and 18 feet width of chamber."

In speaking of the first law, (1834,) they said that "an addi tional set of locks would increase the capacity of the canal about 80 per cent., and might prolong the absolute necessity of enlarging the canal a few years." Also, that "the enlargement of the canal and locks to the proposed dimensions would lesson the expense of transportation, exclusive of tolls, about 50 per cent." This difference, applied to the business of the past year, assuming the expense of transportation to be 20 per cent. greater than the tolls, would be a saving of \$826,007$\frac{81}{100}$, and in ten years, calculating the same rate of increase to the tolls that has taken place in the past ten years, it would amount to \$12,793,221.

The Senate passed a resolution in the session of 1837, asking if the enlargement should be commenced so as to complete the same before the time fixed in the law of 1835, and if the estimate submitted would cover the expense; if not, to state the additional cost.

The Canal Board replied that it ought to be completed before the time fixed in the law of May 11, 1835, and that the cost would materially exceed the estimate of \$12,416,150.

Governor Marcy, in his message to the Legislature of 1838, says: "The unfinished works of internal improvements, including the enlargement, will involve an expenditure of $15,000,000. The best interests of the State appeal to you with great earnestness to provide for the early completion of this important improvement. I respectfully commend this subject to your serious consideration, as one which not only connects itself with the welfare of this State, but with that of the extensive regions of the west."

The Canal Commissioners, on February 13th, 1838, by a resolution of the Assembly, reported, that if funds were provided a large amount of work would of necessity be put under contract.

In 1838, the political power of the two Houses was divided—one party having the ascendency in the Senate, and the other in the Assembly.

On the 13th March, 1838, G. W. Patterson, chairman of the canal committee of the Assembly, reported a bill appropriating one million dollars. The bill was amended, in the committee of the whole, appropriating a further sum of three million dollars, if, in the judgment of the Canal Commisssoners, the interests of the public would be promoted by a more rapid execution of the work. The bill passed the Assembly, April 9th—ayes 91; noes 3. This bill was reported in the Senate by D. S. Dickinson, chairman of the canal committee; but amended in the committee of the whole, on motion of David Wager of Oneida, so as to make the appropriation absolute of four million dollars. It passed the Senate, ayes 17, noes 6, and, being approved by Governor Marcy, became a law April 18, 1838.

On the 12th of April, 1838, Governor Marcy sent in a special message, recommending a law authorizing the Commissioners of the Canal Fund to issue stock to the amount of six or eight millions, for the enlargement of the Erie and completion of the Black River and Genesee Valley canals. His belief was, that "the present crisis must be regarded as one in which it is the duty of the State to stand forth in its strength, and by the use of its credit, and the sanction of its name, to shield its institutions and citizens from harm."

This message was referred in the Assembly to a select committee, consisting of Messrs. Ruggles, Floyd, Miller, Mann, Wordwell, G. W. Patterson and Hurd.

The committee, made a report, April 17th, in which they "most frankly declare, that while they do not anticipate such a state of events as his excellency supposes possible, they at the same time consider it inconsistent or improper to devolve upon the Canal Board, or any other ordinate and merely administrative officers, so vast and dangerous a delegation of the sovereign power."

On the 16th April, 1838, a bill passed the Senate, authorizing the Commissioners of the Canal Fund to issue stocks, as follows: For the Erie enlargement four million dollars; for Genesee Valley canal two million dollars; and for the Black River one and one-half million dollars. It was ordered to a third reading by the following vote:

FOR THE AFFIRMATIVE.

Mr. J. Beardsley,	Mr. Johnson,	Mr. Powers,
S. Beardsley,	H. F. Jones,	Skinner,
D. S. Dickinson,	J. P. Jones,	Sterling,
Downing,	Lawyer,	Van Dyck,
Edwards,	E. P. Livingston,	Wager.
Hunter,	Loomis,	Total—17.

FOR THE NEGATIVE.

Mr. Beckwith,	Mr. A. H. Livingston,	Mr. Verplanck,
Hull,	Maynard,	Works,
Huntington,	Moseley,	Young.
Lacy,	Spraker,	
Lee,	Tallmadge,	Total—13.

The two Houses not agreeing, the bill was lost.

The Canal Commissioners reported, in January, 1840, that the work under contract for the enlargement was $10,683,556, and the amount necessary to complete the existing contracts for the enlargement was $6,500,991. The additional appropriations for that object, made by act, chap. 117, Laws of 1840, were two millions, and by act, chap. 194, Laws of 1841,........ $2,150,000
this fell short of completing their contracts........ 2,350,991
of finishing the Black River canal................ 1,680,095
and of completing the Genesee Valley canal........ 3,188,761

Making a total to complete existing contracts...... $7,209,847
After deducting the appropriations made in 1840 and 1841 for the Black River and Genesee Valley canals, this left the amount to complete existing contracts $5,609,848.

The Commissioners of the Canal Fund add: "It will be seen, that while to one political party must be conceded the credit of originating all the more recent projects of internal improvements, and passing the laws authorizing the construction of the Erie canal enlargement, the Black River and Genesee Valley canals, which have added so much to the public debt, another and adverse party must content themselves with the more humble merit of contributing their aid to carry out the measures which they found already in progress, and providing, or helping to provide the necessary means to preserve the public faith and fulfill the contracts and obligations made and incurred by their predecessors in power."

Black River and Genesee Valley canals—Legislation.

The act authorizing the construction of the Genesee Valley canal passed in 1836. The bill was introduced in the Assembly by Mr. Borland, chairman of the canal committee. The bill passed the Assembly, ayes 81, noes 27, and Senate, ayes 15, noes 11, and approved by Gov. Marcy and became a law May 6, 1836.

The bill authorizing the construction of the Black River canal was reported by Mr. L. Beardsley, chairman of the canal committee of the Senate. The vote upon the third reading of the bill was:

FOR AFFIRMATIVE.

Mr. L. Beardsley,	Mr. Huntington,	Mr. Seger,
Downing,	Kemble,	Spraker,
Fox,	Lawyer,	Sterling,
Gansevoort,	Livingston,	Wager,
Griffin,	Mack,	Willis,
Hubbard,	Maison,	Total—17.

FOR THE NEGATIVE.

Mr. Armstrong,	Mr. Powers,	Mr. Bishop,
J. Beardsley,	Van Schaick,	Loomis,
Edwards,	Beckwith,	Young.
Hunter,		Total—10.

The bill was referred to the canal committee of the Assembly, of which Mr. Borland was chairman, and was reported to the House by Mr. Stryker, of Oneida; it passed the Assembly, ayes 82, noes 18, and being approved by Gov. Marcy, became a law April 19, 1836.

Col. Young alluded to the Legislature of 1836 as follows: "In one session (that of 1836) about nine millions were added to the

liabilities of the State. This was the session that littered the last brood of banks, together with two canals, and the embryo of the New York and Erie railroad."

The amount necessary to complete the Black River and Genesee Valley canals, January 1, 1842, was $3,258,856.

For a complete report of the extent of the salt trade, in this and other States, see Assembly Doc., vol. 2, No. 16, for 1842.

Progress of the Canals in 1842.

The stop law, suspending expenditures on public works, passed March 29, 1842. This law authorized one-half the proceeds of 1 mill tax on real and personal property of 1843, to pay loans and canal debt.

Financial condition of canals.

State debt for public works Sept. 30, 1842	$19,613,359 00
Sum required annually to pay interest on same	1,058,692 00
Amount of principal to be paid within six years	8,169,712 00
Annual canal revenue from all sources	1,798,692 00
Annual canal expenditures and all charges therefrom	1,730,188 00
General Fund and railroad debt	5,124,389 00
Interest annually on same	282,928 00
Total canal and treasury debt	24,737,749 00
Total interest on same annually	1,341,620 00
Total amount of work under contract, including that done and to be done on enlargement	13,022,787 00
Total amount remaining to be done on same	2,315,837 00
Total amount under contract, including that done and to be done on Genesee Valley canal	4,224,700 00
Total amount done and to be done on Black River canal	1,760,046 00
Total amount remaining to be done on same	84,688 00

The Comptroller, in his report for 1842, stated that the Chenango canal cost $2,400,000, and in six years had run the State in debt $726,848 more than its earnings. On the Chemung canal, that cost $316,000, there had been expended, since its completion, including interest, $617,000 more than it had yielded in tolls; that in ten years there had been expended $290,000 for rebuilding locks. The Crooked Lake canal cost the State, since its completion, $97,965 more than it had contributed in

tolls, and finally that the State had sacrificed, in keeping the lateral canals in operation, including Chemung locks, $2,522,577.

The Commissioners, in their report for 1842, stated that the cost of construction and maintenance of the *lateral canals*, up to September 30, 1842, was $11,174,262, and total expended for enlargement $12,727,819, including surplus tolls; amount paid for interest and proceeds of loans, $.

Rebuilding Chemung Locks.

The rebuilding of locks was authorized by act, passed April 27, 1840, chap. 176; the plan for rebuilding left to the discretion of the Commissioners, who caused three estimates and plans to be made, as follows: Composite lock 90x15, $7,263; wooden lock 90x15, $4,390; composite lock 110x18, $11,536; wooden lock 110x18, $5,803. The Commissioners adopted the wooden lock 90x15, $4,390. Fifty-three were put under contract, September 15, 1839, and all brought into use in the spring of 1842.

Navigation.

The average time in making a trip from Albany to Buffalo, in 1841, was 19 days; average burthen of boats $54\frac{9}{12}$ tons; in 1842, was 15 do do do $65\frac{5}{12}$ tons.

Enlargement work.

Combined locks Nos. 3 to 18 inclusive, at Waterford, brought into use in May, 1842.

Rochester aqueduct completed April 1, 1842, at a cost of $445,387. Its whole length is 800 feet, with 7 arches, each 52 feet span. The water-way is 45, and parapet wall 10 feet, making whole width of trunk 65 feet. Its height is 27 feet; and contains 17,000 cubic yards masonry, quarried at Onondaga.

Lockport locks: estimated cost, at contract prices, $610,978. The north tier was brought into use April 1st, 1843. The work consists of five combined double locks $55\frac{10}{12}$ feet lockage, and total length 636 feet.

Supply of Water.

O. W. Childs, (when the water was unusually low,) made accurate gauges of all the streams, from Geddes to Seneca river, that were to be used for enlarged canal feeders. As the result proved an insufficiency, Mr. Childs devised a plan for making a reservoir of Skaneateles lake, by constructing a bulkhead and lowering the outlet five feet, at a cost of $14,927. No immediate action was taken, as work had been suspended.

Genesee Valley Canal.

Was completed, 52 miles to Dansville, November 1st, 1842.

PROGRESS OF THE CANALS IN 1843.

Financial.

Canal debt of each canal, up to September 30th, 1843, as follows:

Erie and Champlain canals	$2,055,143
Erie canal enlargement	9,343,000
Oswego canal	421,304
Cayuga and Seneca canal	237,000
Chemung canal	641,600
Crooked Lake canal	120,000
Chenango canal	2,417,000
Black River canal	1,493,000
do temporary loan	18,967
Genesee Valley canal	3,553,000
Oneida Lake canal	50,000
Improvement Oneida river	61,276
Total	$20,411,291

Classified as follows:

At 5 per cent	$14,872,009	Interest	$743,600
6 do	1,892,145	do	112,762
7 do	3,647,136	do	255,299
Total	$20,411,291	Total	$1,111,662

Total amount tolls received on all the canals, from 1817 to September 30, 1843, was		$24,878,602
For maintenance same period:		
Superintendents of repairs	$6,246,607	
Collectors and inspectors	574,650	
Weigh masters	77,316	
Miscellaneous	747,847	
		7,646,420
Surplus from tolls after paying all expenses		$17,232,182
Deduct interest on loans	$10,635,967	
Received interest on investments	2,022,067	
		8,613,900
Net proceeds after paying interest on loans		$8,618,282

The Original Cost of Canals,

As given in the Comptroller's report, dated January 3d, 1844, with the estimated cost of same:

CANALS.	Cost construction.	Estimated cost—engineer's prices.
Erie canal	$7,143,789 86	$4,926,738 00
Erie enlargement canal	13,291,616 00	*13,291,616 00
Champlain do	1,257,604 26	871,000 00
Oswego do	565,437 35	227,000 00
Cayuga and Seneca canal	236,804 74	153,871 00
Crooked Lake do	156,776 90	119,198 00
Chemung do	641,600 58	331,125 00
Black River do	1,511,967 00	1,068,437 00
Genesee Valley do	3,555,000 00	2,002,285 00
Oneida Lake do	50,000 00	40,000 00
Oneida river improvement	59,432 57	100,050 00
Chenango canal	2,417.000 00	1,960,456 00
	$30,885,029 26	$25,091,776 00

Acts passed, not given in foregoing.

For payments of arrearages to contractors, March 16th, 1843, appropriating $320,000.

For prohibiting members of Canal Board and engineers becoming interested in contracts, April 18th, 1843.

For increasing revenues of the State, by extending the market for salt, coal and lead, April 18th, 1843.

For relief of contractors, allowing prospective damages, April 18th, 1843.

For paying arrearages to contractors, and appropriating $300,000, April 18th, 1843.

Business of the Canals.

By dividing twenty years into periods of four years each an idea can be formed of the increase of lockages, as follows:

Up to and including	1827,	lockages increased	112	per cent.
do	1831,	do	25.22	do
do	1835,	do	58 42	do
do	1839,	decreased	6.06	do
do	1843,	further do	5.15	do

* The estimated cost of enlargement, at engineer's prices, was $23,402,863.23; but, for comparison, the same is inserted of work done to date on enlargement. It appears that the cost of construction was 23 per cent. more than the estimated cost.

The decrease was owing to increased size of boats. The tonnage of boats was from 60 to 70 tons, in 1843, and the heaviest ever transported up to this year was 82 tons, and had a draught of $3\frac{1}{2}$ feet of water. The average draught of boats of 60 to 70 tons was $2\frac{3}{4}$ and 3 feet. The time consumed in a trip from Albany to Buffalo and return was 18 days. Twelve per cent. of all the boats carried cargoes weighing more than 60 tons, and drew from $2\frac{3}{4}$ to 3 feet water.

Progress oe the Canals in 1844.

Actual cost of Crooked Lake canal, exclusive of engineering and extra allowances, as given by Jno. Van Nortwick, at $137,340; average cost of each lock, $1,744; 1 mile canal, $9,487; and 1 bridge, average $135. This was in answer to an Assembly resolution.

Expenditures for support of Government are made chargeable on the General Fund. In 1814 this fund had a capital of $4,396,943.97. The Legislature continued its annual appropriations upon the General Fund until the original capital was exhausted, and a debt created in January, 1845, of $5,634,507.

Extra Allowances.

From 1826 to 1845 nearly $1,000,000 were paid as extra allowances to contractors, beyond the amount for which they agreed to do the work; and on the 1st January, 1845, there were claims of nearly $1,000,000 preferred, growing out of the refusal to permit certain contractors to finish their work. Over $500,000 extra allowances were made by the Canal Board on the Chenango canal, under the Laws of 1836 and 1837; and between Albany and Schenectady, $139,839, under the Laws of 1838 and 1839.

Tonnage of Boats.

The total number of boats navigating the canals Jan. 1st, 1845, was 2,504, classified as follows: 3 of 90 tons burthen, 1 of 85, 515 of 60, 478 of 50, 286 of 70, 358 of 65, 340 of 55, 46 of 75, and 12 of 80 tons burthen. The average of 378 boats, built in 1844, was 64 tons burthen; the average of 2,126 boats, built previous to 1844, was 55 tons burthen; an increase of about 20 per cent. in tonnage.

Progress of the Canals in 1845.

Enlargement Work.

Of the 49 double sets of locks located between Albany and Syracuse, 29 sets and 3 single locks were completed. Of the enlarged canal, 98 miles were completed and in use, at a cost of $3,685,438, seventy-six locks finished at a cost of $2,560,634, making the total cost of work completed and in use prior to April 1st, 1842, $9,361,442, the amount of work not in use $1,245,035, and the total amount of finished and unfinished, $12,436,256.

O. W. Childs, chief engineer, surveyed an independent line for the enlargement across the Cayuga marshes, contemplating the crossing of Seneca river by an aqueduct, located upon a level of the same elevation as that at the west side of the marshes above the lock, making the bottom of canal from 2½ to 3 feet above the level of the marsh. He also made an estimate of the cost of doubling all the locks west of Syracuse, (except guard locks at Pendleton, Tonnawanda, and Black Rock,) at $1,599,664.

Reduction in Rates of Toll.

The following statement shows the extent of the reduction in the rates of toll siuce 1832 up to 1846.

Quantity.	Kind.	1832.	1834.	1836.
1,000 lbs....	Merchandise, toll Albany to Buffalo..	$5.08 2-10	$3.26 7-10	$2.36
1,000 lbs....	Flour and provisions, do ..	2.54	1.62 35-100	1.45 2-10
30 tons	Merchandise, do ..	304.92	196 02	141.57
50 tons	Flour do ..	254.10	163 35	145.20

Chemung Canal.

All the locks were rebuilt under act chap. 176, Laws of 1840.

Crooked Lake Canal.

The rebuilding of all the locks under contract Jan. 1st, 1846.

Cost of Canals, including Loans and Deficiencies paid from the Treasury.

The following statement shows the sums paid from the treasury, and from the Erie and Champlain Canal Fund, on account of

deficiencies in the revenue of the lateral canals, from 1817 to Sept. 30th, 1845, as per report of Commissioners Canal Fund, dated Jan. 7th, 1846, and the number of years each canal has been in operation:

Canals.	Years in operation.	Amounts of Loans, Deficiencies, and Construction.
Erie and Champlain, (including enlargement)	25	$53,512,594
Oswego canal, deficiencies	16	341,618
Cayuga and Seneca, do	16	185,666
Chemung canal do	13	441,171
Crooked Lake canal, do	12	126,607
Chenango canal do	9	1,084,773
Black River canal do	6	432,791
Genesee Valley canal do	7	1,013,515
Oneida Lake canal do	5	22,954
River improvement, dificiencies	6	16,358
Sale of lands appropriated to the Oswego		213,087
Amount of loans for the lateral canals		9,304,180
Total expended for all the canals		$66,695,315
Deduct receipts, all sources, Erie and Champlain		56,195,630
Showing a loss on canals alone of		$10,499,685
Total receipts by Commissioners Canal Fund from 1817		$72,148,786
Total expenditure by Commissioners Canal Fund from 1817		69,436,056
Showing a gain on management of Canal Funds		$2,712,730

(In the above receipts, $29,638,887 were for tolls, and the expenditures for repairs, collection, &c., $7,962,603, showing a revenue of $21,676,284.)

Puddling under Contracts, 1842.

Messrs. O. W Childs and W. J. McAlpine testified before Canal Board that contractors were not entitled to 25 per cent. compression on puddled earth estimated as lining, but should be paid

for the labor of puddling at their contract prices, and 25 per cent. compression the same when used in embankment.

Progress of the Canals in 1846.

Jonas Earll, Jr., one of the Canal Commissioners, and President of the Board, died Oct. 28, 1846, and on the 3d December, John T. Hudson was appointed by the Governor for the unexpired term.

O. W. Childs, chief engineer, by request of the Canal Commissioners, acted during the interim as Canal Commissioner.

The floods of the Oswego river carried away a portion of the Horse-shoe dam and west abutment, March 26, 1846, and excavated a large channel inland, 60 feet wide and from 12 to 16 feet deep. In this emergency the services of Garrett C. Sweet were obtained, who, by his extraordinary skill and experience, checked the breach by running down obliquely a line of cribs, forcing the floods by degrees over the unimpaired portion, and thus saving, contrary to the expectations of the canal officials, this fine structure and one-quarter the season of navigation.

Deposits.

The total amount deposited in the banks from 1824 to 1846, inclusive, was $42,651,458, and the amount of interest received, including interest on investments of surplus stocks, was $2,376,066.

Cost of Chenango canal.

For construction	$2,404,653
Interest on loans	1,239,618
Repairs	173,534
Collection and inspection	13,122
Miscellaneous	17,483
	$3,848,411
Deduct tolls received from 1837	170,281
Total paid from the Treasury	$3,678,130

Progress of the Canals in 1847.

Nathaniel S. Jones resigned the office of Canal Commissioner November 1st, and Thomas Clowes was appointed by the Legislature on the 15th to fill the vacancy.

Supply of Water, Middle Division.

In pursuance of a resolution of the Canal Board, September 20, 1847, O. W. Childs, chief engineer, submitted a report on the practicability, expense and utility, of constructing reservoirs on the Limestone and Chittenango creeks and Cazenovia lake, to supply the Rome level. The following statement gives the result :

Reservoir.	Greatest depth.	Average depth.	Highest embankment.	Area flowed.	Cubical contents. Cubic feet.	Estimated cost.
De Ruyter	65	24	75	580	604,517,540	$84,440 00
Cazenovia Lake..	5	5	..	1,178	257,483,100	5,123 00
Erieville	46	21⅓	56	314	292,438,290	43,416 00
					1,154,438,290	$132,979 00

equal to 5,240 cubic feet per minnte during 153 days, from June to October inclusive. The plan for Cazenovia lake contemplated the cutting down of the outlet five feet, and the drawing of that depth of water from the lake.

To supply that portion, when enlarged, between west end Fort Plain level to the Schoharie creek, a feeder was proposed to extend 3¾ miles above Minden dam to foot lock No. 33, the water to be taken from the Mohawk river by a dam at East creek, and conveyed through a feeder 4¼ miles long, at an estimated cost of $122,703.

The quantity required for the long level, when enlarged, (exclusive of the Utica weigh lock,) and for the daily furnishing of 200 locks at each end, was 20,326 cubic feet per minute. From Minden feeder to Schoharie creek, (other than from the Mohawk river at Minden,) 3,462 cubic feet per minute were required, and for the supply of Black River canal and feeder, (50 lockages per day,) 6,970 cubic feet, making a total quantity of 30,758 c. feet per minute. The supply of this demand, obtained from the following sources, was as follows :

From present feeders on Rome level, including that at Rome and Steel's creek, cubic feet per minute	9,254
From reservoirs above stated	5,240
do Black river canal	16,000
do do do do lockages and leakage	2,100
Total	32,594

Enlargement.

The act of May 12, 1848, appropriated $550,000 for the enlargement.

The plan of enlargement for the Fort Plain level, was the raising of the bottom two feet higher than the old canal.

The Canal Board, accompanied by O. W. Childs, chief engineer, and John D. Fay, resident engineer, met at Buffalo, and after thoroughly inspecting the facilities of transhipment, decided on extensive improvements of Buffalo harbor.

Scientific Report of O. W. Childs, chief engineer, on supply of Water from Lake Erie to Seneca river, for enlarged canal.

In answer to a resolution of the Canal Board, dated April 12th, 1841, directing the chief engineers to report the dimensions and declivity which should be given to that part of the canal when enlarged, between Lockport and Rochester, to supply at all times the canal with water to the Seneca river, without resort to Seneca river, O. W. Childs, by request of Daniel P. Bissell, on behalf of the then Canal Commissioners, submitted, December 30th, 1847, the following report, from which the following important and useful extracts are taken:

"It is perhaps due to the engineers embraced in the resolution, to state, that the paper was drawn up by me in the fall of 1841, with reference to submitting it at the next meeting with my associates, for discussion and amendment; this, owing to the press of other business, and the little prospect of an immediate progress of the enlargement of that part of the canal, was never done, and no further action was had under the resolution."

"Since the date of the resolution, the formulæ used have been tested by the Croton aqueduct, and the quantity conveyed was about 15 per cent. greater than that shown by the results of the application of the formula." This, however, passes over a

smoother surface and presents less impediments than the bottom and sides of the canal."

" The first twelve miles east of Lockport have now an average depth of about six feet, and diminish to five feet in passing 30 miles east."

(Paper A.)

* * " Preferring to err in favor of providing for a larger than a smaller quantity, the number of lockages is assumed at 200 in 24 hours, or one in seven minutes. The chamber of an eight feet lift lock contains 16,320 cubic feet water, and the lockage would amount to 2,267 cubic feet per minute."

" In July last, measurements were made to ascertain the quantity consumed by the present canal, between Wayneport and Pitt lock, a distance of 36 miles. The following statement embraces the results, viz :

PLACES.	Distance, miles.	Quan'y passing per minute.	Loss per mile per minute.	Average loss per mile per minute.
At Wayneport	0.00	3,349	....	....
On Palmyra level	8.34	2,442	108.75	....
On Clyde level	27.68	1,466	35.26	....
Total	32.02	....	....	52.27

Deducting 321 feet lockage water at Pitt lock from the quantity passed, it leaves a loss per minute, from evaporation, leakage and filtration, of 84.05 cubic feet per mile.

" The average quantity consumed on that part of the canal between Pittsford and Lockport, as measured by Mr. Barrett at various points, and repeated daily between the 30th September and 17th July, was 73 cubic feet per min. per mile."

" For the sake of round numbers, 85 cubic feet per min. per mile are taken in the following calculations as the quantity consumed by filtration, leakage and evaporation, which, for a distance of 122 miles, gives total loss 10,370 cubic feet per min."

" Admitting the loss from filtration through the bottom and sides of the canal, and from leakage at the structures to be as thesquare root of the depth, and as the area of the surface

pressed; then the quantity required for the enlarged canal will be to the old as $223\frac{54}{100}$: 100, or $123\frac{54}{100}$ per cent. greater, or 190 cubic feet per min. per mile for the enlarged canal. Adding to this 2,267 lockage water at Pitt lock, makes the whole quantity required 25,448 cubic feet, or 208.59 cubic feet per minute per mile."

The German hydraulician, M. Eytelwein, is among the more modern cultivators of this science. His numerous experiments are said to lead very nearly to the same practical conclusions as those of Bossut and Du Buat. His work, which was published in 1815, evinces as well the labor which he bestowed on this subject, as the care and skill which he practiced in his experiments, and the ability with which his deductions were made. He proposes no alteration in the formula of De Prony, except the numerical of the co-efficients, which is so small as to produce but a trifling effect upon the results, within the limits of ordinary practice. De Prony gave to the equation the form $av+bv^2=RI$, in which a and b are constant quantities, determined by experiment. According to De Prony a=0000444499, and by Eytelwein, 0000242651.

De Prony's numerical value of b=0000942772, and Eytelwein's=0001114155. v represents the mean velocity; R the mean radius, or the area of the section divided by that portion of the perimeter in contact with the water, and I, the fall divided by the length. By this formula every direct cause that can operate to produce an effect upon the motion of fluids, appears to be embraced, and differs from that deduced from the experiments of Coulombe by Gerard, mainly in the co-efficient, as the term expressing the resistance, RI, in the formula of Eytelwein and De Prony, represents nearly the same thing as $\frac{gwz}{hx}$ in that of Gerard.

Mr. Childs, after giving an interesting and graphic sketch of the earliest experiments and advancement in this branch of science, concludes as follows: "The equation of M. De Prony, on account of its being more modern and simple in its application, with the co-efficients of Eytelwein, are used in constructing the following table, with forms varying to suit the cases to which they are applied."

"In the following calculations the canal between Rochester and Lockport is divided into sections, each of which, in the first table, is considered uniform in its prism, consequently the top and bottom planes of the volume are supposed to be parallel."

No. 1.

Tabular view of the dimensions and inclination that may be given to the prism of the canal, and the velocity with which the water, having a uniform depth throughout, will move, to convey 13,290 c. feet per minute, at Rochester, increasing this quantity at the rate of 190 c. feet per minute on each mile west to Lockport. Calculated from the equation before alluded to, of the form $av+bv^2=Ri$. $a=0.0000242651$. $b=0.0001114155$.

QUANTITIES.	Depth.	Bottom width.	Surface width.	Sectional area in feet.	Perimeter.	R. or area divided by perimeter.	$\frac{av+bv^2}{R}$ into the distance=Fall.	Distance in feet.	Velocity in feet per second.
13.290.	8.00	38.00	70.00	432.00	73.78	5.855	.04027	5.641.	.05127
13.493.	8.00	38.35	70.35	434.80	74.13	5.865	.04036	5.583.	.05172
13.694.	8.00	38.70	70.70	437.60	74.48	5.875	.04045	5.527.	.05215
13.893.	8.00	39.05	71.05	440.40	74.83	5.885	.04053	5.472.	.05256
14.090.	8.00	39.40	71.40	443.24	75.18	5.895	.04063	5.419.	.05298
14.285.	8.00	39.75	71.75	446.08	75.53	5.905	.04072	5.380.	.05337
14.478.	8.00	40.10	72.10	448.88	75.88	5.915	.04081	5.341.	.05375
14.670.	8.00	40.45	72.45	451.70	76.23	5.925	.04090	5.304.	.05412
14.860.	8.00	40.80	72.80	454.50	76.58	5.935	.04096	5.309.	.05449
15.051.	8.00	41.15	73.15	457.30	76.93	5.945	.04106	5.216.	.05483
15.239.	8.00	41.50	73.50	460.32	77.28	5.955	.04118	5.196.	.05517
15.425.	8.00	41.85	73.85	463.18	77.53	5.965	.04127	5.161.	.05550
15.611.	8.00	42.20	74.20	466.04	77.98	5.975	.04136	5.138.	.05582
15.795.	8.00	42.55	74.55	468.90	78.33	5.985	.04144	5.104.	.05614
15.978.	8.00	42.90	74.90	471.82	78.68	5.995	.04149	5.056.	.05644
16.160.	8.00	43.25	75.25	474.72	79.03	6.005	.04158	5.035.	.05673
16.340.	8.00	43.60	75.60	477.62	79.38	6.015	.04167	5.004.	.05701
16.520.	8.00	43.95	75.95	480.52	79.73	6.025	.04174	4.981.	.05729
16.699.	8.00	44.30	76.30	483.42	80.08	6.035	.04185	4.962.	.05757
16.877.	8.00	44.65	76.65	486.36	80.43	6.045	.04222	4.966.	.05783
17.054.	8.00	45.16	77.16	489.28	80.78	6.055	.04199	4.919.	.05809
17.230.	8.00	45.52	77.52	492.20	81.13	6.065	.04207	4.889.	.05834
17.404.	8.00	45.89	77.89	495.12	81.48	6.075	.04216	4.879.	.05855
17.578	8.00	46.25	78.25	498.04	81.83	6.085	.04224	4.859.	.05882

No. 1.—Continued.

QUANTITIES.	Depth.	Bottom width.	Surface width.	Sectional area in feet.	Perimeter.	R. or area divided by perimeter.	$\frac{av+bv^2}{R}$ into the dis-t'nce=Fall.	Distance in feet.	Velocity in feet per second.
17.752.	8.00	46.62	78.63	501.04	82.18	6.095	.04232	4.849.	.05903
17.926.	8.00	47.00	79.00	504.00	82.77	6.105	.04241	4.831.	.05978
18.100.	....	47.37	79.37	506.96	83.14	6.115	.04253	4.826.	.05950
18.273.	....	47.74	79.74	509.92	83.51	6.125	.04261	4.807.	.05972
18.445.	....	48.11	80.11	512.90	83.88	6.135	.04264	4.792.	.05993
18.617.	....	48.48	80.48	515.88	84.25	6.145	.04279	4.790.	.06014
18.790.	....	48.85	80.85	518.86	84.62	6.155	.04280	4.773.	.06035
18.962.	....	49.22	81.22	521.84	84.99	6.165	.04289	4.756.	.06055
19.133.	....	49.59	81.59	524.82	85.36	6.175	.04296	4.746.	.06076
19.303.	....	49.96	81.96	527.80	85.73	6.185	.04306	4.759.	.06095
19.473.	....	50.33	82.33	530.90	86.10	6.195	.04315	4.732.	.06113
19.643.	....	50.74	82.74	533.92	86.51	6.171	.04293	4.719.	.06131
19.813.	....	51.12	83.12	536.94	86.89	6.179	.04352	4.710.	.06149
19.982.	....	51.42	83.42	539.36	87.19	6.186	.04362	4.701.	.06167
20.150.	....	51.87	83.87	542.98	87.64	6.195	.04370	4.692.	.06184
20.318.	....	52.26	84.26	546.06	88.03	6.203	.04403	4.709.	.06201
20.487.	....	52.64	84.64	549.12	88.41	6.211	.04399	4.695.	.06217
20.656.	....	53.02	85.02	552.18	88.79	6.218	.04402	4.695.	.06234
20.825.	8.00	53.40	85.40	555.24	89.17	6.226	.04410	4.678.	.06251
20.994.	....	53.78	85.78	558.30	89.55	6.234	.04419	4.670.	.06267
21.162.	....	54.16	86.16	561.40	89.93	6.242	.04425	4.658.	.06282
21.330.	....	54.54	86.54	564.48	90.31	6.250	.04433	4.657.	.06297
21.498.	....	54.92	86.92	567.56	90.69	6.258	.04442	4.657.	.06312
21.665.	....	55.33	87.33	570.66	91.10	6.264	.04456	4.660.	.06327
21.832.	....	55.72	87.72	573.77	91.49	6.271	.04474	4.651.	.06341
21.999.	....	56.11	88.11	576.88	91.88	6.278	.04474	4.651.	.06355
22.166.	....	56.50	88.50	580.00	92.27	6.285	.04480	4.647.	.06369
22.333.	....	56.89	88.89	583.12	92.66	6.292	.04490	4.639.	.06383
22.499.	....	57.28	89.28	586.24	93.05	6.300	.04498	4.638.	.06396
22.665.	....	57.67	89.67	589.38	93.44	6.307	.04507	4.638.	.06409
22.831.	....	58.06	90.06	592.50	93.83	6.314	.04516	4.637.	.06422
22.997.	....	58.45	90.45	595.62	94.22	6.321	.04525	4.636.	.06435

23.163.	....	....	58.84	90.84	598.74	94.61	6.328	.04538	4.640.	.06447
23.329.	....	....	59.23	91.23	601.98	95.00	6.336	.04546	4.639.	.06458
23.496.	....	....	59.65	91.65	605.22	95.42	6.342	.04558	4.640.	.06470
23.663.	....	....	60.04	92.04	608.32	95.81	6.349	.04566	4.639.	.06483
23.830.	....	....	60.43	92.43	611.52	96.20	6.356	.04575	4.638.	.06494
23.996.	....	....	60.82	92.82	614.70	96.59	6.364	.04583	4.645.	.06506
24.163.	....	....	61.17	93.17	617.90	96.94	6.374	.04587	4.641.	.06517
24.329.	....	....	61.62	93.62	621.10	97.39	6.377	.04601	4.643.	.06528
24.490.	....	....	62.01	94.01	624.30	97.78	6.384	.04610	4.643.	.06539
24.663.	....	....	62.40	94.40	627.50	98.17	6.391	.04619	4.642.	.06550
24.830.	....	....	62.79	94.79	630.70	98.56	6.399	.04626	4.648.	.06561
24.997.	....	....	63.24	95.24	633.96	99.10	6.397	.04641	4.647.	.06571
25.164.	....	....	63.63	95.63	637.18	99.40	6.409	.04647	4.647.	.06582
25.331.	....	....	64.05	96.05	640.44	99.83	6.415	.01663	4.650.	.06589
25.450.	....	....	64.46	96.46	643.68	100.24	6.420	.03183	3.196.	.06566
								3,06784 ft. fall		

No. 2.

Tabular view of the necessary dimensions of the prism of the canal, and the inclination that should be given to the surface of the water, (with a horizontal bottom plane,) in order to convey 13,290 cubic feet per minute at Rochester, increasing said quantity by 190 c. feet per mile, per minute, west to Lockport, calculated from the formula

$$ds = \frac{w - \frac{v^2 x}{g}}{z(av + bv^2)} dh;$$

in which $w =$ area of the section; v the velocity; x the width of water at surface; z that portion of the perimeter of the section in contact with the water; g the accelerating force of gravity; h the depth of the water; and ds a differential quantity to be integrated from $h_n = 8$, to h_m, the depth of water sought at the upper end, or at Lockport.

Quantities in cubic feet.	Depth or value of h.	$\frac{m}{n}$, or $h\left(\frac{w}{n}+h\right)$.	Velocity in feet per sec., or $V = \frac{Q}{0\,nh\left(\frac{w}{n}+h\right)}$.	$\frac{v^2}{2g}$	Width of surface in feet or $\frac{2w}{n} + 4h$.	Product of 4th and 5th.	Remainder of 6th from the 2nd.	$\frac{x}{n}$	$av + bv^2$.	Product of 8th and 9th.	Quotient of $\frac{7th}{10th}$	Distance in feet, or product of half the sum of the two first of 11th and constant difference of first.
13.290	8.00	216.00	0.5127	.004084	70.00	.28588	215.71412	36.888	.0000418	.0015419	139901.49	
	8.04	217.40	0.5094	.004032	70.16	.28288	217.11712	36.978	.0000413	.0015272	142166.78	5.641.36
13.493	8.04	217.40	0.5172	.004156	70.16	.29158	217.10842	36.978	.0000424	.0015679	138470.83	
	8.08	218.80	0.5139	.004103	70.32	.28852	218.51148	37.068	.0000419	.0015531	130693.76	5.583.26
13.694	8.08	218.80	0.5215	.004225	70.32	.29710	218.50290	37.068	.0000430	.0015939	137086.95	
	8.12	220.20	0.5182	.004172	70.48	.29404	219.90596	37.158	.0000425	.0015792	139251.49	5.526.77
13.893	8.12	220.20	0.5256	.004292	70.48	.30250	219.89750	37.158	.0000436	.0016201	135730.81	
	8.16	221.62	0.5222	.004236	70.64	.29923	221.32077	37.248	.0000431	.0016054	137860.20	5.471.82

14.090	8.16	221.62	0.5298	.004360	70.64	.30799	221.31201	37.248	.0000442	.0016464	134421.77	
	8.20	223.04	0.5264	.004305	70.80	.30479	222.73521	37.338	.0000437	.0016317	136505.00	5.418.53
14.285	8.20	323.04	0.5337	.004425	70.80	.31329	222.72641	37.338	.0000447	.0016690	133449.91	
	8.24	224.44	0.5304	.004370	70.96	.31009	224.12991	37.428	.0000442	.0016543	135549.91	5.380.00
14.478	8.24	224.44	0.5375	.004488	70.96	.31846	224.12154	37.428	.0000452	.0016917	132483.02	
	8.28	225.85	0.5342	.004433	71.12	.31526	225.53474	37.518	.0000447	.0016770	134583.02	5.341.32
14.670	8.28	225.85	0.5412	.004551	71.12	.32366	225.52634	37.518	.0000457	.0017145	131540.58	
	8.32	227.25	0.5379	.004496	71.28	.32046	226.92954	37.608	.0000452	.0016998	103640.58	5.303.62
14.860	8.32	223.25	0.5449	.004613	71.28	.32884	226.92116	37.608	.0000458	.0017224	131747.07	
	8.36	228.65	0.5416	.004558	71.44	.32564	228.32436	37.698	.0000453	.0017077	133702.85	5.309.00
15.051	8.36	228.75	0.5483	.004671	71.44	.33369	228.39631	37.698	.0000468	.0017643	129454.35	
	8.40	230.16	0.5449	.004613	71.60	.33029	229.82971	37.788	.0000463	.0017496	131361.28	5.216.31
15.239	8.40	230.16	0.5517	.004728	71.60	.33859	229.82141	37.763	.0000472	.0017824	128939.30	
	8.44	231.59	0.5483	.004671	71.76	.33519	231.25481	37.853	.0000467	.0017677	130846.23	5.195.71
15.425	8.44	231.59	0.5550	.004785	71.76	.34337	231.24663	37.853	.0000477	.0018055	128078.99	
	8.48	233.02	0.5516	.004727	71.92	.33997	232.68003	37.943	.0000472	.0017908	129985.92	5.161.30
15.611	8.48	233.02	0.5582	.004841	71.92	.34816	232.67184	37.943	.0000481	.0018250	127491.41	
	8.52	234.45	0.5548	.004783	72.08	.34476	234.10524	38.033	.0000478	.0018103	129398.34	5.137.79
15.795	8.52	234.45	0.5614	.004896	72.08	.35290	234.09710	38.033	.0000486	.0018484	126648.50	
	8.56	235.88	0.5580	.004838	72.24	.34950	235.53050	38.123	.0000481	.0018337	128555.43	5.104.07
15.978	8.56	235.92	0.5644	.004949	72.24	.35751	235.52490	38.140	.0000492	.0018764	125519.55	
	8.60	237.36	0.5609	.004889	72.40	.35396	237.00604	38.230	.0000487	.0018618	127299.41	5.056.38
16.160	8.60	237.36	0.5673	.005000	72.40	.36200	236.99800	38.230	.0000496	.0018962	124985.76	
	8.64	238.81	0.9638	.004940	72.56	.35845	238.45155	38.320	.0000495	.0018816	126764.76	5.035.01
16.340	8.64	238.81	0.5701	.005049	72.56	.36635	238.44363	38.320	.0000501	.0019198	124202.32	
	8.68	240.26	0.5666	.004989	72.72	.36280	239.89720	38.410	.0000496	.0019052	125981.32	5.003.67
16.520	8.68	240.26	0.5729	.005099	72.72	.37080	239.88920	38.410	.0000505	.0019397	123642.36	
	8.72	241.71	0.5694	.005039	72.88	.36725	241.34275	38.500	.0000500	.0019251	125421.36	4.981.27
16.699	8.72	241.71	0.5757	.005149	72.88	.37526	241.33474	38.500	.0000509	.0019596	123155.10	
	8.76	243.26	0.5722	.005089	73.04	.37171	242.88829	38.590	.0000504	.0019450	124934.10	4.961.78
16.877	8.76	243.18	0.5783	.005196	73.04	.37951	242.80069	38.588	.0000514	.0019687	123330.36	
	8.80	244.64	0.5748	.005133	73.20	.37573	244.26427	38.677	.0000509	.0019540	125007.30	4.966.75
17.054	8.80	244.64	0.5809	.005242	73.20	.38371	244.25629	38.677	.0000517	.0019996	122152.57	
	8.84	246.10	0.5774	.005179	73.36	.37993	245.72007	38.766	.0000512	.0019849	123794.68	4.918.94
17.200	8.84	246.10	0.5834	.005288	73.36	.38793	245.71207	38.766	.0000522	.0020235	121429.23	
	8.88	247.56	0.5799	.005225	73.52	.38415	247.17585	38.855	.0000517	.0020088	123046.52	4.889.51
17.404	8.88	247.56	0.5858	.005269	73.52	.38737	247.17263	38.855	.0000525	.0020399	121168.99	
	8.92	249.02	0.5823	.005206	73.68	.38359	248.63641	38.944	.0000520	.0020252	122771.28	4.878.80
17.578	8.92	249.02	0.5882	.005375	73.68	.39603	248.62397	38.944	.0000529	.0020601	120685.38	
	8.96	250.48	0.5848	.005333	73.84	.39231	250.08769	39.033	.0000524	.0020454	122274.33	4.859.20
17.752	8.96	250.52	0.5905	.005413	73.84	.39969	250.12031	39.034	.0000532	.0020766	120447.03	
	9.00	252.00	0.5869	.005351	74.00	.39597	251.60403	39.124	.0000526	.0020619	122025.33	4.849.44

No. 2.—Continued.

Quantities in cubic feet.	Depth, or value of h.	$\frac{w}{n}$, or $h\left(\frac{w}{n}+h\right)$.	Velocity in feet per sec., or $V=\frac{Q}{nh\left(\frac{w}{n}+h\right)}$.	$\frac{v^2}{2g}$	Width of surface in feet, or $\frac{2w}{n}+4h$.	Product of 4th and 5th.	Remainder of 6th from the 2nd.	$\frac{x}{n}$.	$av+bv^2$.	Product of 8th and 9th.	Quotient of $\frac{7th}{10th}$	Distance in feet, or product of half the sum of the two first of 11th and constant difference of 1st.
17.926	9.00	252.00	0.5928	.005459	74.00	.40396	251.59603	39.124	.0000536	.0020970	119976.19	
	9.04	253.48	0.5898	.005395	74.16	.40009	253.47991	39.210	.0000531	.0020823	121556.15	4.830.64
18.100	9.04	253.48	0.5950	.005500	74.16	.40780	253.07219	39.210	.0000539	.0021134	119746.47	
	9.08	254.96	0.5915	.005436	74.32	.40400	254.55600	39.300	.0000534	.0020986	121546.47	4.825.85
18.273	9.08	254.96	0.5972	.005541	74.32	.41181	254.54819	39.300	.0000543	.0021340	119282.18	
	9.12	256.44	0.5937	.005479	74.48	.40800	256.03200	39.390	.0000538	.0021193	120809.70	4.807.28
18.445	9.12	256.45	0.5993	.005580	74.48	.41560	256.03440	39.392	.0000546	.0021508	119041.46	
	9.16	257.94	0.5958	.005515	74.64	.41164	257.52836	39.482	.0000541	.0021359	120571.30	4.792.25
18.617	9.16	257.94	0.6014	.005619	74.64	.41942	257.52058	39.482	.0000549	.0021675	118809.95	
	9.20	259.43	0.5979	.005554	74.80	.41543	259.01457	39.572	.0000544	.0021527	120338.59	4.789.98
18.790	9.20	259.43	0.6035	.005658	74.80	.42322	259.00678	39.572	.0000552	.0021844	118571.13	
	9.24	260.92	0.6000	.005593	74.96	.41925	260.50075	39.662	.0000547	.0021696	120100.13	4.773.42
18.962	9.24	260.92	0.6055	.005696	74.96	.42697	260.49303	39.662	.0000556	.0022052	118126.70	
	9.28	262.41	0.6020	.005631	75.12	.42300	261.98700	39.752	.0000551	.0021904	119655.70	4.755.64
19.133	9.28	262.41	0.6076	.005735	75.12	.43081	261.97919	39.752	.0000559	.0022221	117897.12	
	9.32	263.90	0.6041	.005670	75.28	.42683	263.47317	39.842	.0000554	.0022073	119426.12	4.746.46
19.303	9.32	263.90	0.6095	.005771	75.28	.43444	263.46356	39.842	.0000562	.0022391	117710.49	
	9.36	265.39	0.6060	.005706	75.44	.43046	264.95954	39.932	.0000557	.0022243	119239.49	4.739.00
19.473	9.36	265.45	0.6113	.005845	75.44	.43793	265.01207	39.929	.0000565	.0022559	117475.09	
	9.40	266.96	0.6078	.005739	75.60	.43386	266.52614	40.019	.0000559	.0022371	119139.12	4.732.28
19.643	9.40	266.96	0.6131	.005840	75.60	.44150	266.51850	40.019	.0000568	.0022731	117248.91	
	9.44	268.47	0.6096	.005774	75.76	.45144	268.03256	40.109	.0000563	.0022581	118698.27	4.718.94
19.813	9.44	268.47	0.6149	.005874	75.76	.44501	268.02499	40.109	.0000571	.0022902	117031.26	
	9.48	269.98	0.6114	.005808	75.92	.44095	269.53935	40.199	.0000566	.0022752	118481.26	4.710.25
19.982	9.48	269.98	0.6167	.005908	75.92	.44853	269.53147	40.199	.0000574	.0023074	116811.76	
	9.52	271.49	0.6132	.005842	76.08	.44207	271.04793	40.289	.0000569	.0022924	118237.62	4.700.99

20.150	......	9.52	271.49	0.6184	.005941	76.08	.45222	271.03778	40.289	.0000577	.0023246	116595.45	
		9.56	273.00	0.6149	.005875	76.24	.44816	272.55184	40.379	.0000572	.0023096	118008.25	4.692.07
20.318	......	9.56	273.03	0.6201	.005974	76.24	.45546	272.57454	40.376	.0000580	.0023418	112125.09	
		9.60	274.56	0.6167	.005908	76.40	.45137	274.10863	40.466	.0000574	.0023227	123322.37	4.709.15
20.487	......	9.60	274.56	0.6217	.006005	76.40	.45878	274.10122	40.466	.0000582	.0023512	116579.28	
		9.64	276.09	0.6182	.005939	76.56	.45469	275.63531	40.556	.0000577	.0023321	118191.89	4.695.42
20.656	......	9.64	276.09	0.6234	.006038	76.56	.46227	275.62773	40.556	.0000583	.0023644	116574.06	
		9.68	277.62	0.6199	.005972	76.72	.45818	277.16182	40.646	.0000578	.0023453	118177.55	4.695.03
20.825	......	9.68	277.62	0.6251	.006071	76.72	.46678	277.15324	40.646	.0000587	.0023859	116162.97	
		9.72	279.15	0.6216	.006005	76.86	.46267	278.68733	40.736	.0000582	.0023668	117748.57	4.678.23
20.994	......	9.72	279.15	0.6267	.006102	76.86	.46899	278.68101	40.736	.0000590	.0024034	115952.82	
		9.76	280.68	0.6232	.006036	77.04	.46490	280.21510	40.826	.0000585	.0023843	117525.10	4.669.55
21.162	......	9.76	280.70	0,6282	.006131	77.04	.47233	280.22767	40.824	.0000593	.0024208	115758.28	
		9.80	282.24	0.6248	.006065	77.20	.46821	281.77178	40.913	.0000588	.0024056	117131.60	4.657.79
21.330	......	9.80	282.24	0.6297	.006161	77.20	.47562	281.76437	40.913	.0000595	.0024343	115747.59	
		9.84	283.78	0.6263	.006095	77.36	.47150	283.30850	41.003	.0000590	.0024191	117113.18	4.657.21
21.492	......	9.84	283.78	0.6313	.006190	77.36	.47885	283.30114	41.003	.0000597	.0024478	115737.04	
		9.88	285.32	0.6278	.006124	77.52	.47473	284.84527	41.093	.0000592	.0024327	117090.17	4.656.54
21.665	......	9.88	285.33	0.6327	.006219	77.52	.48209	284.84791	41.093	.0000599	.0024614	115725.97	
		9.92	286.87	0.6293	.006153	77.68	.47797	286.39203	41.183	.0000594	.0024423	117263.24	4.659.78
21.832	......	9.92	286.88	0.6341	.006247	77.68	.48526	286.39474	41.183	.0000602	.0024792	115519.01	
		9.96	288.42	0.6307	.006181	77.84	.48114	287.93886	41.273	.0000597	.0024601	117043.55	4.651.25
21.999	......	9.96	288.44	0.6355	.006274	77.84	.48836	287.95164	41.273	.0000604	.0024928	115513.33	
		10.00	289.98	0.6321	.006208	78.00	.48424	289.49576	41.363	.0000599	.0024737	117029.45	4.650.85
22.166	......	10.00	290.00	0.6369	.006302	78.00	.49155	289.50845	41.360	.0000606	.0025064	115507.68	
		10.04	291.56	0.6335	.006235	78.16	.48732	291.07268	41.450	.0000601	.0024911	116845.04	4.647.05
22.333	......	10.04	291.56	0.6383	.006330	78.16	.49475	291.06525	41.450	.0000609	.0025243	115305.53	
		10.08	293.12	0.6349	.006263	78.32	.49052	292.62948	41.540	.0000604	.0025090	116631.90	4.638.74
22.499	......	10.08	293.12	0.6396	.006355	78.32	.49772	292.62228	41.540	.0000611	.0055380	115296.40	
		10.12	294.68	0.6362	.006288	78.48	.49349	294.18651	41.629	.0000606	.0025227	116615.73	4.638.24
22.665	......	10.12	294.69	0.6409	.006381	78.48	.50078	294.18922	41.629	.0000613	.0025518	115286.94	
		10.16	296.25	0.6375	.006314	78.64	.49655	295.75345	41.719	.0000608	.0025365	116599.03	4.637 71
22.831	......	10.16	296.25	0.6422	.006407	78.64	.50384	295.74616	41.719	.0000615	.0025657	115269.15	
		10.20	297.81	0.6388	.006340	78.80	.49961	297.31039	41.809	.0000610	.0025504	116574.02	4.636.86
22.997	......	10.20	297.81	0.6435	.006434	78.80	.50699	297.30301	41.809	.0000617	.0025796	115251.59	
		10.24	299.37	0.6401	.006367	78.96	.50276	298.86724	41.899	.0000612	.0025643	116549.24	4.636.01
23.163	......	10.24	299.37	0.6447	.006457	79.96	.50984	298.86016	41.899	.0000619	.0025935	115234.30	
		10.28	300.99	0.6413	.006389	79.12	.50549	300.48451	41.989	.0000613	.0025739	116742.88	4.639.54
23.329	......	10.28	300.99	0.6458	.006479	79.12	.51261	300.47739	41.989	.0000621	.0026075	115235.81	
		10.32	302.61	0.6424	.006419	79.28	.50826	302.10174	42.079	.0000615	.0025879	116736.24	4.639.44
23.496	......	10.32	302.61	0.6470	.006503	79.28	.51555	302.09445	42.076	.0000623	.0026213	115246.04	
		10.36	304.23	0.6436	.006435	79.44	.51120	303.71880	42.165	.0000617	.0026017	116738.59	4.639.69

No. 2.—Continued.

Quantities in cubic feet.	Depth, or value of h.	$\frac{w}{n}$, or $h\left(\frac{w}{n}+h\right)$.	Velocity in feet per sec., or $V=\frac{Q}{nh\left(\frac{w}{n}+h\right)}$.	$\frac{v^2}{2g}$	Width of surface in feet, or $\frac{2w}{n}+4h$.	Product of 4th and 5th.	Remainder of 6th from the 2nd.	$\frac{x}{n}$.	$av+bv^2$.	Product of 8th and 9th.	Quotient of $\frac{7\text{th}}{10\text{th}}$	Distance in feet, or product of half the sum of the two first of 11th and constant difference of 1st.
23.663	10.36	304.16	0.6483	.006529	79.44	.51866	303.64134	42.165	.0000625	.0026353	115250.17	
	10.40	305.78	0.6449	.006461	79.60	.51431	305.26569	42.254	.0000619	.0026152	116705.16	4.639.10
23.830	10.40	305.76	0.6494	.006552	79.60	.52153	305.23847	42.254	.0000627	.0026493	115214.75	
	10.44	307.38	0.6460	.006484	79.76	.51718	306.86282	42.343	.0000621	.0026292	116700.06	4.638.29
23.996	10.44	307.35	0.6506	.006576	79.76	.52450	306.82550	42.343	.0000028	.0026591	115386.97	
	10.48	308.97	0.6470	.006508	79.92	.52015	308.44985	42.432	.0000622	.0026395	116859.19	4.644.92
24.163	10.48	308.95	0.6517	.006598	79.92	.52731	308.42269	42.433	.0000630	.0026732	115375.83	
	10.52	310.55	0.6483	.006529	80.08	.52284	310.02716	42.523	.0000625	.0026576	116656.81	4.640.65
24.329	10.52	310.55	0.6528	.006620	80.08	.53012	310.01988	42.523	.0000632	.0026874	115360.52	
	10.56	312.15	0.6494	.006551	80.24	.52565	311.62435	42.612	.0000627	.0026678	116809.48	4.643.40
24.496	10.56	312.15	0.6539	.006643	80.24	.53303	311.61697	42.612	.0000634	.0027016	115348.07	
	10.60	313.75	0.6505	.006574	80.40	.52856	313.22144	42.701	.0000629	.0026820	116786.50	4.642.69
24.663	10.60	313.75	0.6550	.006870	80.40	.55234	313.19763	42.701	.0000636	.0027157	115328.51	
	10.64	315.35	0.6516	.006801	80.56	.54787	314.80213	42.790	.0000631	.0026961	116762.03	4.641.81
24.830	10.64	315.35	0.6561	.006688	80.56	.53878	314.81122	42.790	.0000637	.0027257	115497.38	
	10.68	316.95	0.6527	.006619	80.72	.53431	316.41569	42.880	.0000632	.0027061	116926.82	4.648.48
24.997	10.68	316.98	0.6571	.006708	80.70	.54433	316.43867	42.881	.0000639	.0027400	115488.56	
	10.72	218.50	0.6537	.006639	80.86	.53686	317.96314	42.971	.0000634	.0027204	116881.02	4.647.39
25.164	10.72	318.59	0.6582	.006730	80.88	.54432	318.04568	42.971	.0000641	.0027544	115468.22	
	10.76	320.19	0.6548	.006661	81.04	.53985	319.65015	43.061	.0000636	.0027348	116882.45	4.647.01
25.331	10.76	320.22	0.6589	.006747	81.04	.54661	319.67339	43.061	.0000642	.0027645	115635.15	
	10.80	321.84	0.6556	.006676	81.20	.54209	321.29791	43.152	.0000637	.0027487	116890.81	4 650.51
25.450	10.80	321.84	0.6589	.006745	81.20	.54769	321.29231	43.152	.0000644	.0027854	116758.56	
	10.828	322.97	0.6566	.006698	81.31	.54461	322.43529	43.210	.0000640	.0027650	116596.25	3.196.96

Inclination of surface = 2.828.

It will be observed, that the aggregate fall of the surface required in the first, is shown to be something greater than that in the second table. This is to be attributed to the greater friction, arising from a larger surface of prism in contact with the water.

For reasons before alluded to, it is not believed that the prism of the canal should take either of the forms resulting from the calculations, as shown in the foregoing tables. An inclination of the bottom of the canal, as great as that of the surface of the water, during the time of sending forward the largest quantity, would, to preserve the minimum depth at Lockport, render it necessary that the supply be constant, and at all times equal to the maximum requirements of the canal. The current, as shown by the tables, would be nearly half a mile per hour, an amount too great for convenient navigation, consequently should be avoided as great a portion of the season as may be consistent with a due observance of economy in construction. As some inclination to the surface will be required during the time of sending forward the minimum quantity, a corresponding inclination may be given to the bottom; or, in other words, the top and bottom plane of the volume may be more nearly parallel during the minimum flow, retaining a depth during this time not greater than is necessary for navigation; provided economy in construction would permit the enlarged canal to take this form of prism.

Assuming, therefore, this minimum quantity at the amount required to supply the loss from filtration, &c., from Lockport to Rochester, relying for lockage water, and for all other demands east of the Seneca river, during the more wet portions of the season upon supplies from the Genesee river, we wish to ascertain the inclination that may be given to the bottom, retaining the same transverse section as in the second table.

For this purpose, the following table has been calculated, with the same formula as the first; commencing with 190 c. feet per minute upon the first, and increasing by the same amount upon every succeeding mile west, to Lockport.

No. 3.

Quantity.	Depth.	Bottom width.	Surface width.	Area.	Perimeter.	R, or $\frac{\text{area}}{\text{perimeter}}$.	$\frac{av + bv^2}{R}$ + distance = descent.	Distance.	Velocity.	$av + bv^2$.
190	8.00	38.00	70.00	432.00	73.78	5.585	.00019	5.280	.0073	.00000022
380							.00039		.0146	.00000044
570							.00059		.0220	.00000066
760							.00079		.0293	.00000088
950							.00098		.0366	.00000109
1.140							.00117		.0439	.00000131
1.330							.00137		.0512	.00000153
1.520							.00165		.0585	.00000184
1.710							.00191		.0658	.00000213
1.900							.00218		.0731	.00000242
2.090							.00243		.0804	.00000271
2.280							.00288		.0877	.00000300
2.470							.00297		.0950	.00000330
2.660							.00323		.1023	.00000359
2.850							.00360		.1096	.00000400
3.040							.00394		.1169	.00000438
3.230							.00428		.1243	.00000476
3.420							.00461		.1312	.00000512
3.610	8.10	38.00	70.00	432.00	73.78	5.585	.00498	5.280	.1392	.00000553
3.800							.00528		.1465	.00000591
3.990							.00564		.1539	.00000630
4.180							.00612		.1612	.00000681
4.370							.00654		.1685	.00000728
4.560							.00696		.1759	.00000775
4.750							.00739		.1832	.00000822
4.940							.00781		.1905	.00000869
5.130							.00823		.1978	.00000915
5.320							.00865		.2052	.00000963

5.510								.00918		.2125	.00001022
5.700								.00966		.2199	.00001077
5.890								.01019		.2272	.00001131
6.080								.01066		.2345	.00001185
6.270								.01114		.2418	.00001239
6.466								.01161		.2491	.00001293
6.650								.01219		.2565	.00001355
6.840								.01277		.2638	.00001418
7.030								.01335		.2712	.00001482
7.220								.01388		.2785	.00001545
7.410								.01446		.2858	.00001607
7.600								.01504		.2931	.00001670
7.790								.01562		.3005	.00001734
7.980								.01626		.3078	.00001804
8.170								.01689		.3151	.00001874
8.360								.01752		.3225	.00001946
8.550								.01816		.3298	.00002016
8.740								.01879		.3371	.00002086
8.930		8.00	38.00	70.00	432.00	73.78	5.855	.01943	5.280	.3445	.00002157
9.120								.02006		.3518	.00002227
9.310								.02080		.3591	.00002308
9.500								.02148		.3664	.00002387
9.690								.02222		.3738	.00002467
9.880								.02291		.3811	.00002545
10.070								.02365		.3884	.00002624
10.260								.02434		.3958	.00002704
10.450								.02508		.4031	.00002783
10.640								.02587		.4104	.00002874
10.830								.02666		.4177	.00002962
11.020								.02750		.4251	.00003051
11.210								.02824		.4324	.00003138
11.400								.02904		.4397	.00003226
11.590								.02988		.4471	.00003315
11.780								.03067		.4544	.00003402
11.970								.03157		.4618	.00003503
12.160								.03241		.4691	.00003598
12.350								.03326		.4764	.00003693
								.84918			

From this table it appears that an aggregate fall of $\frac{85}{100}$ of a foot will be required to send forward the quantity assumed as above stated, giving to the surface at Lockport an elevation of $8\frac{85}{100}$ feet above the level of the bottom at the lower end, or point of starting. Deducting from this the requisite depth for navigation, (or 7 feet,) and reducing the depth of water represented to be necessary at the upper end, in table No. 2, by the remainder, 1.85, and adding its equivalent area at the bottom, or that due to its depth to the side of the volume represented in said table No. 2, would give the sectional area as before, 645.94 feet, leaving a depth of 8.98 feet, and would increase the bottom width to 53.99 feet, and the surface width to 89.91 feet. This, it will be perceived, will admit of a variation in the elevation of the surface of $1\frac{98}{100}$ feet, and during the minimum flow the volume would have a depth at the upper end of 7 feet, and the surface an inclination of $\frac{85}{100}$ feet, and the bottom $1\frac{85}{100}$ feet in a distance of 65 miles; and during the maximum flow, or time of sending forward the largest quantity required, the surface would have an inclination of $2\frac{83}{100}$ feet, and the bottom the same as above, 1 85-100 feet.

By this change of the prism, the perimeter, and consequently the friction, will be a little increased, and an inclination a trifle greater will be required to produce the same velocity as is stated in the second table. In the case of minimum flow, however, a depth of 7 feet in the prism thus modified, furnishes a sectional area a trifle larger than that used in constructing table No. 3; consequently the flow will be somewhat greater. This, however, being so small as to produce no material or sensible effect upon the supply, no special provision on account of it is thought to be necessary.

With reference to a more full understanding of the form and dimensions that may be given to the prism of this section of the canal, another case is presented in the following table, (No 4,) which is calculated from the same formula as the first, for the purpose of showing the dimensions and inclination necessary to convey the same quantity, as in the first and second, with a velocity of half a mile per hour, from Lockport so far east as an increase to the regular dimensions of the prism is required, to convey the quantity with this velocity.

No. 4.

Distance in miles.	Depth in feet.	Quantity per minute in cubic feet.	Surface width in feet.	Bottom width in feet.	Transverse section. Area in feet.	Perimeter.	Mean radius.	$\frac{av+bv^2}{R}=I.$	Velocity per second in feet.	$I\times$ distance = descent.
1	8.00	25.450	88.3011	56.3011	578.4090	92.0723	[illegible].2821	.00001236	0.733	.0652608
2		25.260	87.7613	55.7613	574.0909	91.5325	6.2719	.00001238		.0653664
3		25.070	87.2216	55.2216	569.7727	90.9928	6.2617	.00001240		.0654720
4		24.880	86.6818	54.6818	565.4545	90.4530	6.2513	.00001242		.0655776
5		24.690	86.1420	54.1420	561.1363	89.9132	6.2409	.00001245		.0657360
6		24.500	85.6022	53.6022	556.8131	89.3734	6.2302	.00001247		.0658416
7		24.310	84.9375	52.9375	551.4999	88.7087	[illegible].2169	.00001249		.0659472
8		24.120	84.3977	52.3977	547.1817	88.1689	6.2060	.00001251		.0660528
9		23.930	83.9829	51.9829	543.8636	87.7541	6.1975	.00001253		.0661584
10		23.740	83.4431	51.4431	539.5454	87.2143	6.1864	.00001255		.0662640
11		23.550	82.9034	50.9034	535.2272	86.6746	6.1751	.00001258		.0662640
12		23.360	82.2613	50.2613	530.0909	86.0325	6.1615	.00001261		.0665808
13		23.170	81.8238	49.8238	526.5909	85.5950	6.1521	.00001263		.0666864
14		22.980	81.2841	49.2841	522.2727	85.0553	6.1403	.00001265		.0667920
15		22.790	80.7443	48.7443	517.9545	84.5155	6.1285	.00001267		.0668976
16		22.600	80.2045	48.2045	513.6363	83.9757	6.1164	.00001269		.0670032
17		22.410	79.6647	47.6647	509.3181	83.4359	6.1042	.00001272		.0671616
18		22.220	79.1250	47.1250	505.0000	82.8962	6.0919	.00001275		.0673200
19		22.030	78.5852	46.5852	500.6818	82.3564	6.0794	.00001278		.0674784
20		21.840	78.0454	46.0454	496.3636	81.8166	6.0667	.00001280		.0675840
21		21.650	77.5056	45.5056	492.0454	81.2768	6.0538	.00001283		.0677424
22		21.460	76.9659	44.9659	487.7272	80.7371	6.0409	.00001286		.0689008
23		21.270	76.4261	44.4261	483.4090	80.1973	6.0277	.00001289		.0680592
24		21.080	75.8863	43.8863	479.0909	79.6575	6.0143	.00001292		.0682176
25		20.890	75.3466	43.3466	474.7727	79.1178	6.0008	.00001295		.0683760
26		20.700	74.8068	42.8068	470.4545	78.5780	5.9871	.00001297		.0684816
27		20.510	74.2670	42.2670	466.1363	78.0382	5.9731	.00001300		.0686400
28		20.320	73.6477	41.6477	461.1818	77.4189	5.9569	.00001304		.0688512

No. 4.—Continued.

Distance in miles.	Depth in feet.	Quantity per minute in cubic feet.	Surface width in feet.	Bottom width in feet.	Transverse section. Area in feet.	Perimeter.	Mean radius.	$\frac{av+bv^2}{R}=I.$	Velocity per second in feet.	$I \times$ distance = descent.
29	....	20.130	73.1875	41.1875	457.5000	76.9587	5.9447	.00001306	....	.0689568
30	....	19.940	72.6477	40.6477	453.1818	76.4189	5.9302	.00001308	....	.0690624
31	....	19.750	72.1079	40.1079	448.8638	75.8791	5.9155	.00001311	....	.0692208
32	....	19.560	71.5681	39.5681	444.5454	75.3393	5.9005	.00001316	....	.0694848
33	....	19.370	71.0284	39.0284	440.2272	74.7996	5.8854	.00001320	....	.0696960
34	....	19.180	70.4886	38.4886	435.9090	74.2598	5.8705	.00001323	....	.0698544
									$\frac{2}{\frac{\text{area}}{60}}$ =velocity	
35	....	18.990	70.00	38.00	432.00	73.7712	5.8559	.00001325	.7326	.0699600
36	....	18.800	....	....	....	....	....	.00001302	.7253	.0687456
37	....	18.610	....	....	....	....	....	.00001279	.7179	.0675312
38	....	18.420	....	....	....	....	....	.00001257	.7106	.0663686
39	....	18.230	....	....	....	....	....	.00001233	.7033	.0651024
40	....	18.040	....	....	....	....	....	.00001198	.6960	.0632524
41	....	17.850	....	....	....	....	....	.00001178	.6887	.0621984
42	....	17.660	....	....	....	....	....	.00001157	.6813	.0610896
43	....	17.470	....	....	....	....	....	.00001137	.6739	.0600336
44	....	17.280	....	....	....	....	....	.00001116	.6665	.0589248
45	....	17.090	....	....	....	....	....	.00001096	.6591	.0578688
46	....	16.900	....	....	....	....	....	.00001077	.6520	.0568656
47	....	16.710	....	....	....	....	....	.00001057	.6446	.0558096
48	....	16.520	....	....	....	....	....	.00001037	.6372	.0547536
49	....	16.330	....	....	....	....	....	.00001016	.6298	.0536448

50			16.140						.00000996	.6226	.0525888
51			15.950						.00000970	.6153	.0512160
52			15.760						.00000956	.6080	.0504768
53			15.570						.00000936	.6007	.0474208
54			15.380						.00000916	.5933	.0483648
55			15.190						.00000896	.5859	.0473088
56			15.000						.00000876	.5786	.0462588
57			14.810						.00000857	.5713	.0452496
58			14.620						.00000838	.5640	.0442464
59			14.430						.00000818	.5567	.0431904
60			14.240						.00000800	.5494	.0422400
61			14.050						.00000783	.5420	.0413424
62			13.860						.00000763	.5347	.0402864
63			13.670						.00000745	.5274	.0393360
64			13.480						.00000730	.5200	.0385440
65			13.290						.00000712	.5127	.0375936
	Fall in last 31 miles										1.6398136
	Fall in first 34 miles										2.2899788
	Total fall in 65 miles										3.9297924

From this table, it appears that the quantity diminishing by 190 cubic feet per mile, becomes so much reduced, that a prism of 8 feet in depth, with 38 feet bottom width, would convey it with the velocity assumed, at the 35th mile from Lockport; and as the quantity continues to diminish, the inclination and velocity also diminish upon each succeeding mile, to the first lock east of Rochester.

Should a maximum velocity, as high as that assumed in the above table, be adopted, and the supplies for the canal east of Rochester be drawn from the Genesee river, at such times as a surplus beyond the quantity required for all other purposes may be passing in that stream; then, changing the form of the prism represented in the above table, (retaining the same sectional area,) by increasing the depth to 9.98 feet, and reducing the bottom w dth to 38, and surface width to 77.92 ft., would give a form similar to that obtained from table No. 2, after reducing the depth and increasing the width stated in that table, as before specified.

This change in the prism of table No. 4, gives a bottom inclination of 1.95 feet, and as the transverse section due to a depth of 7 feet is less than that used in constructing table No. 3, a small increase to this depth of water, and also the velocity stated in said table, will be necessary to convey the minimum quantity.

RECAPITULATION

Of the results produced by a modification of tables No. 2 and 4, as above suggested, constituting Plans No. 1 and 2.

	MAXIMUM FLOW.							MINIMUM FLOW.						
	Width at bottom.	Width at surface.	Depth in feet.	Descent in bottom in whole distance or in 65 miles.	Descent in surface in 65 miles.	Sectional area.	Velocity per hour in feet.	Width at bottom.	Width at surface.	Depth in feet.	Descent in bottom in 65 m'ls.	Descent in surface in 65 miles.	Sectional area.	Velocity per hour in feet.
At upper or Lockport end:														
Plan No. 1	53.99	89.91	8.98	1.85	2.83	645.94	2364.	53.99	81.99	7.00	1.85	0.85	475.93	1715
Plan No. 2	38.00	77.92	9.98	1.95	3.93	578.41	2640.	38.	....	....	1.95	....	....	....
At lower end, or at the first lock east of Rochester:														
Plan No. 1	38.	70.	8.	....	....	432.	1846.	38.	70.	8.	....	....	432.	......
Plan No. 2	38.	70.	8.	....	....	432.	1846.	38.	....	....	....	....	....	......

For the purpose of testing, in some degree, the accuracy of the results deduced from the application of the foregoing formula in a single case, a portion of the artificial outlet of the Onondaga lake, 12 chains, or 792 feet in length was taken. This outlet has a length of about 40 chains, and extends in a direct line from the Onondaga lake to the Seneca river. It has a fall quite uniform throughout, of about 5 inches. The section selected was about equi-distant between the lake and river, and by instrumental observation, was found to have a descent of $\frac{12}{100}$ feet; it was slightly variable, and transversely the least erea measured was 120.38 feet, which is something less than a similar section of the present Erie canal.

The formula of M. De Prony, with Eytelwein's coëfficients, gave as the mean velocity due to this descent, $1\frac{82}{100}$ feet per second, and that of Du Buat $1\frac{79}{100}$ feet. The velocity at the surface, as observed was $1\frac{45}{100}$ feet, which reduced to a mean, $1\frac{13}{100}$; showing a difference of 0.69, as compared with the former, and 0.66 with the latter; or about 60 per cent. greater than they should to correspond with the results as observed. There appears to be a fair agreement in the two formulas with each other, but a considerable difference between them both and the result of the observation. This may be accounted for in part, by the variableness of the section, and irregular or rough surface of the bottom and sides, which appeared to be somewhat greater than is usually found upon the surface of the sides and bottom of a canal.

It is further accounted for by the velocity not having attained a maximum, or the volume was still under the influence of the accelerating force of gravity, as was shown by the velocity being greatest at the lower end of the section taken.

It is believed that the formula will produce results corresponding very nearly with the facts, when applied to cases of prisms of larger dimensions and more moderate velocities. This opinion is derived from observation, and from the circumstance that, in the formula, no allowance is made for obstructions arising from counter currents, produced by sensible variations in the surface of the channel, which, in cases of high velocities, must be very considerable. In a case of great inclination it is supposed that it would be difficult to make an experiment in which there would be no deviation from the parallel motions of the filaments, or from an unbroken movement of the particles by continuous lines, supposed to take place in a case of uniform

motion; though whatever of obstructions there may have been produced by the derangement of this order of the movement of the particles in contact with a smooth surface, in the numerous cases of experiments published, it is presumed are quite nearly represented by the coëfficients in the formula deduced from them. In cases of equal volumes and inclination, the velocity diminishes with the increase of the length of the perimeter; the perimeter should, therefore, in all cases, be increased in proportion to the increase of the surface in contact with the water; and, although the formula would, if the perimeter was taken at an amount precisely suited to circumstances, produce correct results when applied to rough channels; no assignable ratio of variation of this quantity can be given, that would be perfectly suited to various velocities, or admit of general application.

It, therefore, appears, that as the experiments from which the several formula above written were deduced, were made in channels having comparatively smooth surfaces, some allowance should be made in cases of their application to channels under different conditions, the amount of which should be governed by circumstances, and can only be approximated by judging from a series of careful observations.

Admitting, however, that the formula will vary as much from the truth when applied, as in the present instance, to a moderate velocity, as it did in the case of the experiment above recited; and the velocity prove less than it is shown will be produced by the inclinations given in plans No. 1 and 2; then, as the banks will have the usual elevation of three feet above the surface of the water, the inclination may be increased by raising the water at the upper end, say one foot, and as the lower end is calculated to have a depth of 8 feet, one foot may be drawn from the surface at this point, increasing thereby the inclination 2 feet, or about 70 per cent.; an amount greater by 10 per cent. than the discrepancy shown by the results of the application of the formula, and by observations in the experiment above alluded to. This increased declivity, notwithstanding the bottom at the lower end would have 4 feet less than the ordinary width, it is supposed would be practicable for short periods, without serious inconvenience to navigation. For reasons before mentioned, however, it is believed that so great an inclination will never be required; this view is strengthened by the opinion that the quantity assumed in the calculations to be necessary for filtration, will prove

liberal, and that after the enlarged canal shall have been in use a few years, the losses from this cause will be diminished.

Table No. 1 is given for the purpose of comparing the results of the formula used in this, with that produced by the one used in the construction of table No. 2. It also shows one form that may be given to the prism. On account of facilities of flow, the prisms represented in plans No. 1 and 2 are considered favorable, and should they be equally favorable in point of economy in construction, a preference is given to No. 1, for the reason that the velocity is thought too great in either case, for the most economical navigation; but the additional expense attending the adoption of the first, will probably be so great as to justify the construction of this section of the canal upon the second or some similar plan. This could better be determined from an actual survey and estimate upon both plans, and from a knowledge of the disadvantages to the navigation, arising from velocities greater or less than the most favorable.

With the tonnage equal in both directions, it is clear that the economy of transportation would not be improved by a current. It is, also, probable, that the construction of the canal upon such plan as with the present difference in the up and down freight, would most favor the navigation, and convey, at the same time, the required quantity of water, would considerably enhance the expense.

Although hitherto there has been in the aggregate a large and assignable difference in the amount of freight transported in opposite directions, there is too much probability of a variation in the ratio of difference that now exists, and too many modifying causes, to justify the application of any rule for determining the velocity that would be best suited to future circumstances.

The most favorable current with the present preponderance of tonnage, would probably not exceed one-third of a mile per hour; and a prism if enlarged to the ordinary dimensions would convey the quantity of water required, with a velocity of about $\frac{3}{4}$ of a mile per hour.

If the above premises are correct and it should be determined not to subject the navigation to a current as great as that last named, then it is obvious that some sacrifice of economy in construction to favor the navigation by an extra enlargement of the prism will be necessary; and if the supply to Seneca river is to be brought from Lake Erie, considerations of safety as well as

convenience to navigation, indicate the propriety of this extra enlargement, and that the depth of the volume be at least proportionately increased.

It will be observed that the construction of the canal, agreeable to table No. 4, which provides for a depth of 8 feet, and a prism at the westerly end sufficiently large to convey the quantity with a velocity of half a mile to the hour, would require a constant supply, as before stated, nearly equal to the maximum requirements of the canal to be kept up at the upper end, or the surface in approaching a level would be liable to become so much reduced, that less than the required depth for navigation would be afforded. Any diminution, therefore, of the quantity introduced at this point, which might be the result of accident or otherwise, would tend to endanger the navigation.

The relative expense of constructing the canal upon plans Nos. 1 and 2 as compared with the ordinary enlargement, may, to some extent, be inferred from the following statements of dimensions:

	Feet.
The distance from one exterior of the bank to the other at bottom line of the canal in plan No. 1, is	169.83
The distance from one exterior of the bank to the other at bottom line of the canal in plan No. 2, is	161.84
The distance from one exterior of the bank to the other at bottom line of the ordinary enlargement	142.00

Or the horizontal space occupied by the canal at the bottom plane in plan No. 1, is about 19 per cent., and plan No. 2 is about 14 per cent. greater than in the case of ordinary enlargement.

The area of the transverse section, in case of equal cutting, or where the excavation is just sufficient to form the banks, is upon ....plan No. 1, about 316 feet.

do do do do do 330 "

do do do ordinary enlargement, 230 "

Or the section of excavation upon plan No. 1, is about 37 per cent., and plan No. 2 about 43 per cent. greater, than a similar section of the ordinary enlargement.

The above dimensions apply to the largest section, or that at the upper end, and as the extra enlargement diminishes as we proceed from Lockport towards Rochester, and in plan No. 2 runs out to 8 feet depth and 70 feet surface width at the 35th mile from Lockport, the cubical quantity necessary to be removed as compared with the ordinary enlargement, would average but

about half of that above indicated, and would apply to a distance of 35 miles.

In view of all the circumstances known to have an influence upon this subject, it is believed that the adoption of plan No. 2 would best insure the attainment of the object to be accomplished by an extra enlargement of the prism between Lockport and Rochester.

A reliable source of supply not heretofore considered, is the feeder leading from the Oak orchard and Tonawanda creeks. The minimum quantity to be supplied through this feeder is stated by Mr. Barrett at about 1,600 cubic feet per minute, which is to be received into the canal at Medina, 18 miles east of Lockport. It will be perceived that in the calculations no deduction from the quantity to be brought from Lake Erie is made on this account. Whatever of excess may be furnished at this point, beyond that stated in the foregoing calculations, it is considered should be held available for contingent demands that may be produced by the several causes before mentioned, by the increase of filtration consequent upon the extra enlargement of the prism, and by that which will be thrown off by the weigh lock at Rochester.

In the calculation of the quantity required for lockage water, it will be recollected that the number of lockages, or times of filling the lock, is taken at 200 every 24 hours. With this number of lockages and with a single lock, a much larger number of boats can be passed. Agreeable to an account kept by the lock-tender at the east lock at Macedon, from July 6th to 31st inclusive, with 884 locks full of water there were passed 1,837 boats and other floats. During the month of August, with 1,092 lockages, 1,749 boats, &c., were passed; and in September 1,091 lockages passed 1,769 boats; or for the whole time from July 6th to September 30th, the number of boats and other floats was about 62 per cent. greater than the number of times that the lock was filled.

With double locks, it is supposed that comparatively few locks full of water would be lost, and the number of boats will be nearly double the number of locks full of water.

The profiles and diagrams hereunto annexed, represent the inclination and form indicated for the prism by the several tables, also by plans Nos. 1 and 2.

Work partially resumed.

By acts passed May 12th 1847,

Upon the enlargement of the Erie, by an appropriation of			$717,620
do	Black River canal and feeder	do	100,000
do	Genesee Valley canal	do	128,000
do	Oneida river improvement	do	20,000
do	Oswego canal (enlargement of locks)	do	100,000

The above law authorized the Commissioners to charge the excess of the cost of rebuilding the old locks and structures on the enlarged plan to the Enlargement Fund on the Erie and Oswego canals. Under this law the second tier of the Lockport locks were commenced in August, 1847. The locks on the Oswego canal, by the above act, were not to be enlarged until one new lock had been constructed on the Erie at each point, from Syracuse to Buffalo.

The new Constitution was adopted in Convention at Albany, October 9, 1846, to take effect January 1st, 1847, and provided for the election of a State Engineer and Surveyor.

Charles B. Stewart was the first State Engineer elected under the Constitution, Nov. 2, 1847.

Progress of the Canals in 1848.

The amounts appropriated for the resumption of the public works, by the Laws of 1847 and 1848	$2,695,000
Amount of work contracted under same	2,250,000
do paid on same	1,070,773

Cayuga and Seneca Canal.

Enlargement of the locks, authorized by act, May 25th, 1836, was commenced at Waterloo, as directed by act, chap. 348, Laws 1847. The estimated cost of composite lock directed to be built, was $12,673, the size to be the same as the enlarged Erie locks.

Th eoffice of Auditor of the Canal Department was created by act, chap. 162, Laws of 1848. His duties were to report to the Legislature the tolls of the canals, and prepare an annual exhibit of the trade and tonnage, substantially as the same was given in the report of 1847. The forms and tables under which that report was made, were designed by George W. Newell, Esq., and the reports of the Auditor on tolls, trade and tonnage,

which have since followed, have contained a mass of statistics covering every point of interest connected with the subject of our State canals.

Crooked Lake Canal.

The rebuilding of all the locks (authorized by acts, chap. 338, Laws 1845, and chap. 249, Laws 1847) was completed during the year at a cost of $57,706 ; they were brought into use May 8, 1848.

Comparative Business of the Erie Canal.

Total value of imports (exclusive of specie) into the United States, for the year ending June 30, 1848, $154,977,876
Total value of all articles transported on the canals in 1847 151,563,428
Total value of American lake commerce same period 141,310,551

Average cargoes on canal in 1847 were 67 tons, in 1848, 71½ tons burthen.

Average time, Troy to Buffalo, in 1847, 10½ days, in 1848, 9 days.

Canal Commissioners under the new Constitution.

It was determined by lot, as provided in sec. 3, article 5, of the Constitution, that Charles Cook should hold the office for one year, Nelson J. Beach for two, and Jacob Hinds for three years. Chas. Cook was appointed president, and N. J. Beach secretary.

The annual report was made under act, chapter 350, Laws 1847.

During the year Erieville reservoir was put under contract at an estimated cost of $23,313 ; the weigh lock at Syracuse at $19,878, and lock No. 50 at $46,618.

Oneida River Improvement.

This improvement has a length of about $19\frac{4}{80}$ miles, and extends from the Oneida lake to the Oswego canal at Three-river Point. The whole descent from the lake to the Oswego river and canal, is $9\frac{14}{100}$ feet, of which, previous to the work having been commenced, $1\frac{42}{100}$ feet occurred in a distance of 30 chains, immediately at the outlet of the lake: $3\frac{69}{100}$ feet in a distance of 50 chains, embracing the Caughanay rapids, about four miles from the lake ; 2.82–100 feet occurring in a distance of 43 chains at the Oak orchard rapids, situated about six miles below the rapids at Caughanay, and the remainder of the fall, amounting to 1.21–100 feet occurred between the points above mentioned,

and between Oak orchard and theOswego canal, though mainly in the latter portion of the river on the first $1\frac{1}{2}$ miles below the Oak orchard rapids.

The plan of the improvement contemplates a reduction of the surface of the Oneida lake about 1.25–100 feet by means of a thorough cut through the two bars at the outlet. The cut through the upper bar is to have a depth of about five feet, and an average width of 93 feet at the point of deepest cutting. 6.25–100 feet of the remainder of the fall is overcome by two locks of substantial stone masonry, $30\frac{1}{2}$ by 120 feet dimensions of chamber, one of 3.25 feet lift is constructed at the lower end of a cut excavated along the south shore of the river through the rapids at Caughanay, and an embankment placed on the outer side of the cut, extends from the lock to deep water above the rapid: the other lock has a lift of three feet, and is located at the southerly end of the dam, constructed across the river at the foot of the rapids at Oak orchard, which elevates the water at the foot to the same level as that above the head of the rapid. The remainder of the fall, 1.64 feet, will, during the ordinary summer flow, be distributed along the surface the entire length of the river, in amounts varying on the several distances with the area of the transverse section of the stream.

The work of the improvement of this river, exclusive of that connected with the mechanical structures, was originally divided into four sections. The first extended from deep water in the lake to the head of the rapids at Caughanay, a distance of 4.4–80 miles. The second extended from the termination of the first to the head of the rapids at Oak orchard, a distance of 6.6–80 miles. The third embraced the last mentioned rapids, and had a length of 78.80 miles; and the fourth had a length of 7.76–80 miles, and included the remainder of the distance to Three-river Point.

Progress of the Canals in 1849.

Number and tonnage of boats.

The total number of boats on the canals in 1849, was 4,863, classified as follows: 20 boats of from 100 to 180 tons burthen, 2,000 of 75 to 95 tons, 2,157 of 50 to 70, 150 of 30 to 45 tons burthen, and the remainder from 10 to 30 tons. Average for 3,700 boats, $67\frac{4}{5}$ tons.

Enlargement and supply of water.

Henry Tracy, Esq., was directed by the Canal Board to make the necessary examinations and gauges, first, as to the size of the prism necessary to pass a sufficient supply of water through the mountain ridge for 200 lockages at Clyde; and, secondly, the size and best form of the prism east of Lockport for the same number of lockages. From the results of Mr. Tracy's examinations, the Commissioners fixed the size of the prism, between Sulphur spring and Tonawanda creek, at a width of 100 feet at surface, and a depth of eight feet. (For Mr. Tracy's report, see progress canals for 1850.)

Black River Canal.

Thirty-five miles were completed and water let in November, 1849, and the feeder finished June, 1848. The feeder was four feet in depth, and passed 16,000 cubic feet of water per minute.

Dimensions of Enlargement changed.

The plan of the prism and lock chambers were changed February 17th, 1849, by Commissioners Cook, Beach and Hind; the prism by constructing the walls to the bottom of canal, and dispensing with the bench walls, adding, as they state, to the capacity of the canal for transportation nearly one-third; the "big bevels" in the locks were dispensed with, and form of masonry changed at the foot, thus adding seven tons to the capacity of a boat drawing 6½ feet of water. The following diagrams illustrate the changes made.

PROGRESS OF THE CANALS IN 1850.

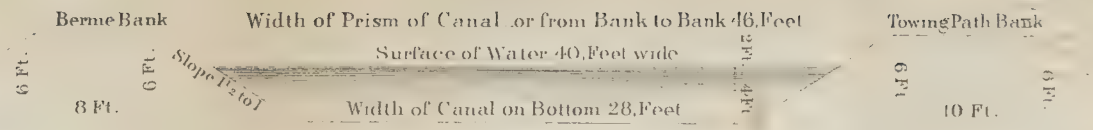
First Annual Report of State Engineer and Surveyor.

Under act, chapter 377, Laws of 1850, in which are given the condition, cost of completion from new surveys and estimates of the enlargement, Black River and Genesee Valley canals at $10,508,141, as follows:

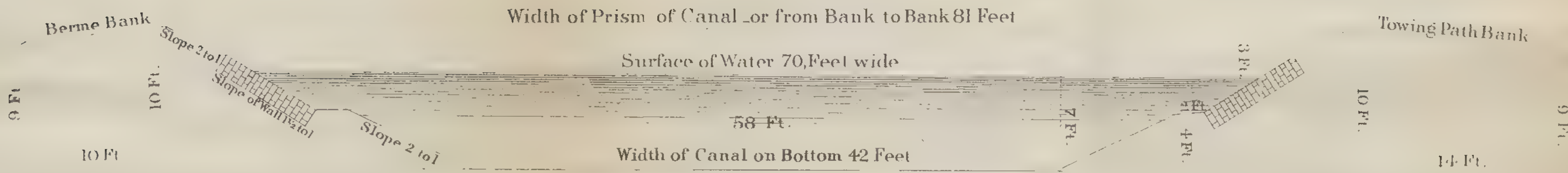
To complete the enlargement of the Erie canal..	$9,510,331 00
To complete the Black River canal...........	388,888 00
To complete the Genesee Valley canal	608,922 00
Total to complete canals.................	$10,508,141 00

At the date of the report there were $110\frac{14}{100}$ miles of enlarged canal completed and in use, $61\frac{14}{100}$ miles under contract, and $188\frac{34}{100}$ not commenced. H. C. Seymour, State Engineer and

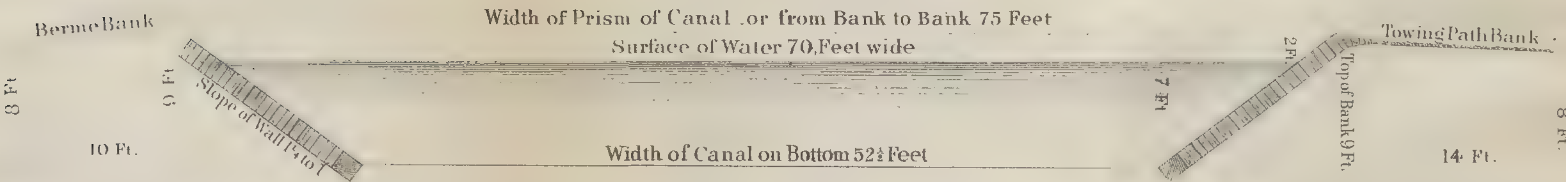
No. 1.



No. 2.



No. 3.

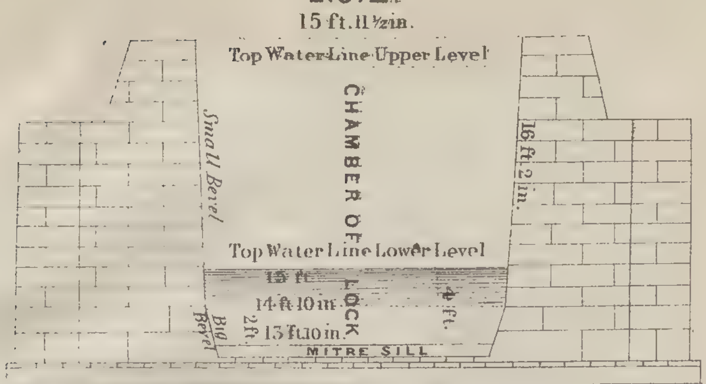


S. H. SWEET
Deputy State Engineer and Surveyor.

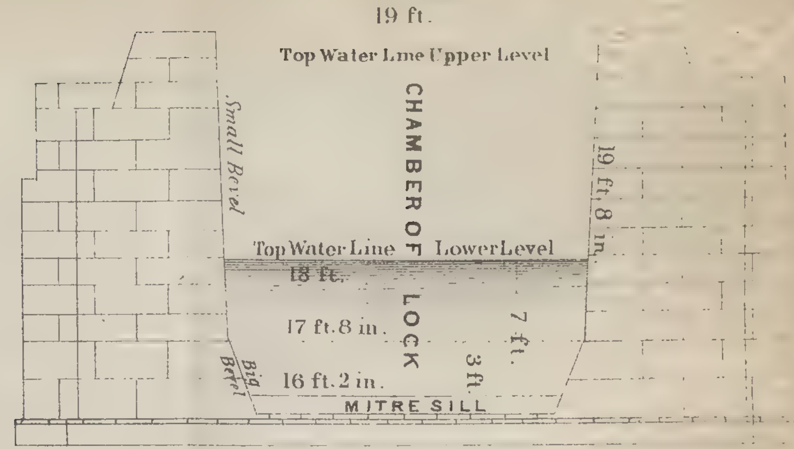
CROSS SECTION OF BLACK RIVER LOCK

CROSS SECTION OF ENLARGED LOCK

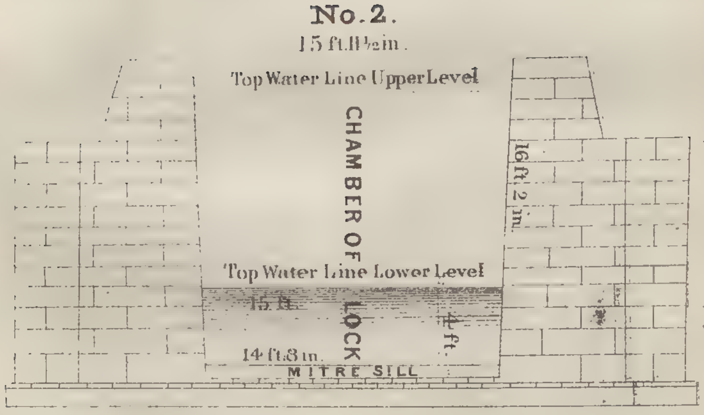
Black River Lock — No. 1.



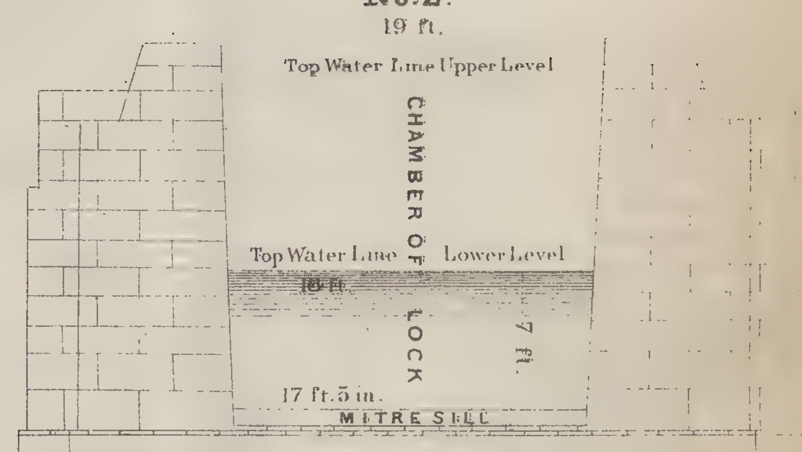
Enlarged Lock — No. 1.



Black River Lock — No. 2.



Enlarged Lock — No. 2.



Surveyor, states in his report that "the original estimates of the cost of the enlargement have been found too low, but a perusal of its history shows that the Canal Commissioners overruled their decisions and adopted more expensive plans."

Mr. Seymour estimated that the business upon the canals during the season of 1850 was equal to six double track railroads, requiring 10,000 cars and 400 engines, at a cost of nine million dollars; and that when the enlargement should be completed the business would equal eight or ten double track railroads.

In relation to transportation, Mr. Seymour stated that the *cost of transportation* on the old canals, with single locks, and before improvements were made in the capacity of boats, was from \$7.40 to \$6.30 per ton, or $1\frac{9}{10}$ cents per ton per mile. The average rates for 1850, varied during the year from \$4.44 to \$6.94 per ton through, at an average of \$5.69 or $1\frac{56}{100}$ cents per ton per mile, of which the State received nearly half for tolls; the estimated cost of transportation on the enlarged canal was \$2.40 per ton, or $6\frac{7}{10}$ mills per ton per mile—3 mills for tolls and $3\frac{7}{10}$ mills charges. Mr. Olmsted, division engineer, estimated that the enlargement would save 36 per cent. in the cost of transportation.

Black River Canal.

Daniel C. Jenne, resident engineer, submitted a report on the improvement of Black river by longitudinal dams, jetties and piling; also on the means of furnishing water for the supply of Black River canal. He estimated the natural flow of Black river in low water $2\frac{14}{100}$ miles below High fall at 28,350 cubic feet per minute, which at $8\frac{1}{3}$ miles below left 28,812 cubic feet, and at 22 miles below left 76,680 cubic feet per minute. By raising the surface to five feet depth, and making an inclination of $1\frac{45}{100}$ feet, the increased flow would be 34,000 cubic feet per minute. Mr. Jenne stated that in extreme freshets the water rose twenty-two feet at the foot of High falls, making a descent in the surface to Carthage of twenty-three feet, and a flow of 210,945 cubic feet per minute. For the increased supply, see following report of Daniel C. Jenne, resident engineer:

REPORT.

The Black River canal diverges from the Erie canal at the village of Rome, and terminates at the village of Carthage, in

Jefferson county, a distance of about 77½ miles. Of this distance about 35 miles is to be an independent canal, and the balance of 42½ miles, slackwater navigation of the Black river. To this is added a navigable feeder, 10 miles in length, taken from the Black river, about 20 miles above the High falls, or the point where the canal enters the river.

The feeder is also designed as a feeder for the enlarged Erie canal, and has been extensively relied on in all the original estimates for a supply of water for said canal.

The capacity of the feeder is such as to pass 16,000 cubic feet per minute; and the surplus beyond what is necessary to supply the Black River canal, will pass to the Erie.

All the measurements which were taken in the early progress of this work, have made the volume of water in the Black river, at the point where it is diverted, from 14,000 to 16,000 cubic feet per minute, at its minimum flow.

The amount of water in the Black river at the place above referred to, at its lowest stage, during the summer of 1849, was only about 9,000 cubic feet per minute, making a deficiency of former estimates of from 5,000 to 7,000 cubic feet per minute.

It should be remarked here, however, that the water was lower than ever before known by those who have been familiar with the river for the last thirty years.

Nearly the whole volume of water was diverted for about three months in 1849 to feed the Erie canal, which left the river nearly dry from the head of the feeder to the High falls, and reducing it from 30 to 40 per cent. below the falls. Moose river enters the Black river a few rods above the falls, and Beaver river 32½ miles below.

There is extensive water power between the head of the feeder and the High falls, which was almost entirely useless during the time the water was diverted from the river in 1849, and the water power between the falls and Lake Ontario was materially injured, rendering a considerable portion of it (as I am informed) nearly unavailable.

Unless an amount of water be restored to the Black river equal to the quantity thus diverted for the supply of the Black River and Erie canals, heavy damages to water power will ensue, the amount of which will be almost incalculable.

The plan proposed by this Department to obtain an increased supply of water for the purposes above mentioned, is to construct

reservoirs of the numerous lakes situated from 10 to 20 miles east of the head of the Black river feeder.

The Wood Hull has its source from these lakes, and is a prominent branch of the Black river, entering the same about three-quarters of a mile above the State dam.

By the directions of Hon. Nelson J. Beach, late Canal Commissioner, surveys of two of said lakes, viz.: the Wood Hull and Wolf, were made in September and October of 1849, which were found to contain an area of 1,163 acres, receiving a drainage of about 5,000 acres of land, These two lakes are near each other, and on about the same level, the Wolf lake emptying into the Wood Hull.

A temporary dam was constructed across the outlet of Wood Hull lake, which would raise the water about five feet. It was closed on the 9th of November last, and the reservoir was filled in 110 days; there was nothing more than an ordinary flow of water during the meantime, as the surface of the ground was for the most of the time covered with snow in the vicinity of these lakes, and was four feet deep when the water commenced running over the dam.

From all the facts in my possession, I am of the opinion, that if the dam had been raised to a height of 12 feet, and closed on the 20th of September, it would have filled by the 10th of June; and that the surface would have been increased about two-fifths, making 1,637 acres; and an average of 1,400 acres, by 12 feet in depth, would afford a reservoir of 731,808,000 cubic feet capacity.

This would furnish 9,000 cubic feet per minute for 56½ days, and 16,000 cubic feet per minute for 31¾ days.

I have assumed that 110 days would be about the time that an increased supply of water would be necessary to draw from the reservoir, and that the ordinary flow into it during the 110 days would be equal to the loss from evaporation and filtration.

If this be a correct basis, it would then require two reservoirs of dimensions like the above, to keep up the supply, or restore the 9,000 cubic feet per minute, and about 3½ such to make good the 16,000 cubic feet per minute.

There is a continous chain of lakes within a few miles of those above described, which are sources of the Wood Hull creek, and which, from the best information I can at present obtain, can be

turned into reservoirs, with equal facilities, and about the same expense.

These last mentioned lakes have not been examined by myself or my assistants, and I can only report, therefore, from general information. I have, however, no doubt but that the above quantity of water can be obtained from these sources.

As to the necessity and practicability of constructing reservoirs on the head waters of the Moose and Beaver rivers, I would state that the sources of these rivers and the lake from which they flow, have not been examined by myself or my assistants, and, therefore, I can only base my conclusions upon general information.

At the head of the Moose river the natural advantages afforded for a reservoir are considered almost unsurpassed. The outlet of the lower lake is narrow, with prominent banks on each side, whereby the expense of daming will not be great, and an area of several square miles can be flowed with a low dam.

I am not in possession of sufficient data on which to base an estimate of the cost of constructing reservoirs at the head of these streams, but I should consider it safe to assume that they could be built at about the same expense as those at the Wood Hull and Wolf lakes.

While it must be apparent that the reservoirs on the Moose and Beaver rivers will not result in an equal amount of benefit that they would if the water was rendered available at the State dam, yet it should not be forgotten that they will vastly enhance the facilities of navigating the Black river, not only by retaining the surplus water in time of floods, affording greater security to the improvements on the river, but also increasing the depth of water in the river at a time when it would otherwise be low. I would add in conclusion, that these sources would furnish such an ample supply of water as to satisfactorily adjust all claims in future relative to damages to water power on the Black river, below High falls.

DANIEL C. JENNE,
Resident Engineer.

ENGINEER'S OFFICE, *Boonville, March* 30, 1850.

Erieville reservoir completed in March, 1850.

Enlargement of Lateral Canals.

Majority report of the Canal Commissioners on Enlargement of Canals other than the Erie.

Canal Commissioners' Office,
Albany, *March* 5, 1850.

To the President of the Senate:

In compliance with the following resolution—

"In Senate, Feb. 12, 1850.

"*Resolved*, That the Canal Commissioners be requested to report to the Senate the plan or plans projected or adopted since 1st of January, 1848, for the enlargement of any of the State canals, other than the Erie canal; or of any channel, section, or portion of the same now or hereafter to be connected therewith; (whether by said plan or plans connected therewith,) whether by said plan or plans or connections with other navigable waters are to be discontinued, and to what extent; the location, cost or estimated cost of each portion now under contract; the amount done and remaining to be done; the law by which authorized, and the fund out of which the cost of each is payable; also a description of the plan and estimates of the cost of rebuilding the several locks, except on the Erie canal, now under contract, of the original and of the enlarged size; the changes, if any, in their location; the cost of bringing them into use, resulting from such changes, the authority for the same, and the fund from which the cost is payable.

"By order,
(Signed) W. H. BOGART, *Clerk.*"

The Canal Commissioners submit the following report:

That the Oswego canal extends from Syracuse to Oswego, a distance of $38\frac{26}{100}$ miles, $19\frac{7}{10}$ miles of which is made by slack water in the Oswego and Seneca rivers, and $18\frac{56}{100}$ miles is independent canal. There are located upon it, 18 lift locks, 6 guard locks, 8 dams, 1 aqueduct, 2 waste weirs, 5 culverts, 4 double track, 16 single track, 1 farm, 2 towing paths, and 6 change bridges.

This navigation, made up alternately of canal and river, is, in many places, very difficult and expensive to maintain.

Act, chap. 214, Laws of 1849, is in the following words

"The sum of one hundred thousand dollars appropriated to the Oswego canal, by chap. 262, Laws of 1847, together with the

interest accumulated thereon, is hereby re-appropriated, for the purpose of rebuilding the locks on said canal, as fast as the condition of said locks shall render it necessary to be done.

"It shall be the duty of the Canal Commissioners, in rebuilding the locks on said canal, to construct them of the size of the enlarged locks on the Erie canal; and when, in their opinion, the public interest will be promoted thereby, the said Commissioners are hereby authorized to change the location of any of the said locks, and to diminish their number, and to do the necessary section work to bring them into use.

"It shall be the duty of said Canal Commissioners to cause accurate estimates to be made of the cost of rebuilding said locks of the present dimensions, and also of constructing the enlarged locks, and whatever the expense of such enlarged locks shall exceed the estimated cost of locks of the present dimensions, shall be paid out of the money hereby re-appropriated; and the residue of such cost, with the cost of such other work as may be constructed under this act, shall be charged to ordinary repairs."

Owing to the rapidly failing condition of the combined locks Nos. 9 and 10, at Fulton, and lock No. 15 at the "high-dam," it was found necessary to prepare the work for letting at these points as early in the season of 1849 as the necessary surveys and estimates could be made.

For this purpose, and in view of so arranging the levels as to dispense with some of the structures (should the plan prove practicable), the portion between Oswego falls and Oswego, a distance of twelve miles, was surveyed, and comparative estimates of the cost submitted:

1st. On the plan of continuing the present connection of the canal with the river.

2d. On the plan of separating it from the river, and dispensing with some of the structures.

The work now under contract on the Oswego canal consists of locks Nos. 8, 9, and 10; section No. 27, half a mile in length; two road bridges at Fulton; locks Nos. 15, 16, 17, and 18; sections Nos. 36½, 37, 37½, and 38, each half a mile in length; one aqueduct, and one road bridge at Oswego.

The river portion of the canal, now made by dam No. 4, at Fulton, is half a mile in length, and embraces the main part of the section work now under contract at that point. At the point

where the old canal leaves the pond, and in immediate contact with it, a mill-race has been constructed, on which a large milling interest is growing up. This, together with the machinery at each end of the dam, creates a large demand for water. Consequently, much difficulty has been experienced at this point from the want of water to supply the canal.

The new line at Oswego passes over the river portion made by dam No. 8, a mile and a half, then across the Oswego Company's mill-race, then along the same half a mile to the termination at Oswego. For many years past serious difficulties have been experienced on this portion of the canal, both from the want of water, which has been drawn for the use of machinery on the race, and from the danger of navigating it in consequence of the current. A large amount of machinery is also in motion on the west side of the river, and drawing water from the same source.

Much has been said in former reports of the Canal Commissioners in relation to it, and much has been done; still the navigation has at all times been difficult. The demand for water at this point, it is thought, will more than keep pace with any improvement, short of an entire separation of the canal from the race.

The result, therefore, has been the adoption of a plan which, when fully completed, will dispense with one dam and two guard locks at Fulton, one dam, one guard lock, and two change bridges at Oswego, making an entire separation of the canal from the river at Fulton by constructing an independent canal through the pond, and at Oswego by an independent canal from the "high dam," crossing the Oswego company's mill-race and canal by an aqueduct.

The estimates of the engineer are for an enlarged canal of 52 feet width at bottom, and 7 feet water. The line follows a side hill the greater part of the distance from the high dam to the termination at Oswego. It adds but little to the cost of construction, whether the line is a few feet nearer or farther from the hill. It is intended to complete that portion from the terminating lock to the aqueduct in the city of Oswego, of the enlarged size, a distance of about half a mile. This being done, the citizens can make their erections along the same without the fear of being disturbed by the State in completing these unfinished portions of the canal through cities and villages. This is believed to be for the mutual interest of the State and the land owners adjoining the canal.

From the aqueduct to the high dam, a distance of about one and a half miles, the embankment will be raised to sufficient height to give four feet of water for navigation, which will reduce considerably the estimated cost of this work. These remarks will equally apply to the work through the village of Fulton.

The absence of the engineer prevents us from stating the changes contemplated by his surveys, in the location of the locks between Oswego and Fulton, but the Commissioners understand that their present location will be substantially maintained.

There are but three points upon this canal where important and desirable alterations are required; these are at Oswego, at Fulton and Salina; these alterations, the Commissioners have no hesitation in saying, the public interest requires. To rebuild the locks at those points at their present locations, might well be considered a waste of money.

These improvements, when completed, will separate the present connection with the river at Fulton and Oswego. Locks will be required to continue this connection, but as the Commissioners have no power to construct them, none have been provided for.

The following statement shows the cost of rebuilding the locks now under contract on the Oswego canal, of the original and of the enlarged size, at engineer's estimated prices:

	Cost of locks of original size.	Cost of locks of enlarged size.
Guard lock No. 3	$14,506 00	
do 4	12,071 00	
do 6	14,003 00	
Lift lock No. 8	31,573 00	$41,331 00
do 9	16,018 00	28,892 00
do 10	16,018 00	25,834 00
do 15	24,082 00	29,728 00
do 16	20,718 00	29,180 00
do 17	18,357 00	30,251 00
do 18	18,357 00	36,745 00
	$185,703 00	$221,961 00

The following statement shows the cost of rebuilding the locks now under contract on the Oswego canal of the enlarged size, the amount done and remaining to be done.

	Cost of locks of enlarged size at contract prices.	Payments made on work done.	Work remaining to be done.
Lock No. 8	$34,480 00	$6,150 00	$32,330 00
do 9	27,296 00	10,615 00	16,681 00
do 10	24,100 00	11,060 00	13,040 00
do 15	24,101 00		24,101 00
do 16	22,440 00	1,230 00	21,210 00
do 17	24,071 00		24,071 00
do 18	30,728 00	500 00	30,228 00
	$187,216 00	$29,555 00	$157,661 00

Payments on the above work are made under act, chap. 214, Laws of 1849.

A statement showing the cost of the work under contract on the Oswego canal at contract prices. necessary to bring the locks into use, the amount done and remaining to be done.

	Cost at contract prices.	Payments made on work done.	Work remaining to be done.
Section No. 27	$36,408 00	$630 00	$35,778 00
do 36½	26,555 00		26,555 00
do 37	25,025 00		25,025 00
do 37½	19,555 00	365 00	19,190 00
do 38	49,447 00		49,447 00
Aqueduct at Oswego	27,600 00	350 00	27,250 00
2 road bridges at Fulton	3,567 00		3,567 00
1 do at Oswego	1,929 00		1,929 00
			$188,741 00
Moving buildings		523 00	523 00
	$190,086 00	$1,868 00	$188,218 00

Payments on the above work are made under act, chap. 214, Laws of 1849.

Cayuga and Seneca Canal.

This canal is 23 miles in length, extending from the Erie canal at Montezuma to the Cayuga lake at East Cayuga, and to the Seneca lake at Geneva. The most important structures upon it are 12 locks, 6 dams, 13 road, 1 farm, and 27 towing path bridges.

The navigation, commencing at Montezuma, is made up of an independent canal to East Cayuga, and the main line to Seneca

lake is made up of alternate portions of independent canal and slack water navigation formed by dams in the Seneca river.

The locks on the line of this canal were constructed of wood, and are much decayed; they require the greatest care to preserve them in a condition for use.

Act, chap. 453, Laws of 1836, provides as follows:

"§ 1. The Canal Commissioners shall, as soon as the locks on the Cayuga and Seneca canal require to be rebuilt, rebuild said locks in a substantial manner with stone, and of the same width as the enlarged locks on the Erie canal."

§ 2. Relates to the Glens Falls feeder.

Act, chap. 348, Laws of 1847, provides as follows:

"§ 1. Whenever in the opinion of the Canal Commissioners, it becomes necessary to substitute new locks for the old locks in the Cayuga and Seneca canal, the Commissioners shall cause minute estimates to be made of the cost of rebuilding the lock or locks on the plan prescribed by the act entitled 'An act for the construction of the locks in the Cayuga and Seneca canal, and the west branch feeder of the Champlain canal,' passed May 25, 1836, and also minute estimates of the cost of constructing said locks of composite, of the same dimensions of the enlarged locks on the Erie canal, which estimates shall be submitted to the Canal Board, and when approved by that Board, and if the expense of the composite locks of the enlarged size shall not exceed the expense of the stone locks as prescribed by the act of May 25, 1836, aforesaid, the Canal Commissioners shall proceed to construct the lock or locks on the enlarged plan, and the cost thereof shall be charged to the fund appropriated to ordinary repairs.

"§ 2. The said Commissioners may diminish the number of the said locks, or alter their location, if in their judgment the interest of the State will be promoted thereby; and the aggregate expense of reconstructing the necessary locks and putting said canal in navigable condition will not be increased thereby."

Under the provisions of the foregoing acts, the Commissioners believing the time had arrived when it was necessary to substitute new locks for the old locks, in July, 1848, directed Charles W. Wentz, a resident engineer in the employ of the State to make a survey and estimate of the cost of constructing the locks upon the plan prescribed by the act, chap. 453, Laws of 1836, and also an estimate for constructing the locks of composite upon the plan contemplated by act, chap. 348, Laws of 1847.

By the report and estimate of the engineer, the aggregate cost of constructing the locks upon the plan prescribed by the act of 1836, was estimated at $188,769.64, and upon the composite plan

prescribed by the act of 1847, the aggregate cost was estimated at $139,416.07, showing a difference in the aggregate in favor of the composite plan of $49,353.57.

In accordance with the provision in the act of 1847, the estimates of the engineer were submitted to the Canal Board, and on the 25th day of July, 1848, the following action was taken thereon by that Board.

Tuesday, July 25th, 1848.

"Present, the Secretary of State, Comptroller, Treasurer, Attorney General, State Engineer and Surveyor, Commissioners Cook and Beach.

"The plans and estimates for substituting new locks for the old locks on the Cayuga and Seneca canal having been submitted to this Board by the Canal Commissioners as required by the act, chap. 348, Laws of 1847, from which it appears that the cost of constructing all of said locks as required by chap. 453, Laws of 1836, is $188,769.64, and the cost of constructing said locks of composite, with cut stone wings, hollow quoins and recesses of the dimensions of the enlarged locks on the Erie canal, is $139,416.07, therefore in conformity with the provisions of said act, chap. 348, Laws of 1847,

"*Resolved*, That this Board approves and recommends the construction of the composite lock of the same dimensions as the enlarged locks on the Erie canal."

Connections with the navigable waters to be discontinued.

This canal as now constructed is connected by a race at the foot of the upper lock in Seneca Falls, with the pond which supplies water to the mills of Dows and Cary, on the north side of the river, and Oatman and others on the south side; by this race, boats pass from the canal into the pond, and thus have access to the mills located upon it for loading and discharging freight. This connection, which is important to those mills, can only be sustained by constructing a lock of four feet lift, through which to pass boats from the canal to their race. If this plan should be adopted it would keep up the connection of the canal with the race and slip, and at the same time prevent drawing water from the canal for milling purposes; which, although an important consideration to the State, the Commissioners have no authority to construct a lock for such purpose.

Changes in the location of locks.

Lock No. 1, one and a half miles from Geneva, is to be dispensed with under the act, chapter 313, Laws of 1844.

The lock at Chamberlain's, between Waterloo and Seneca Falls, is to be dispensed with by raising the dam at Seneca Falls, and raising the towing-path from the lock to Seneca Falls to correspond; for the estimated cost of this change, see estimates annexed.

The only additional change contemplated by the plan adopted, occurs at the upper lock at Seneca Falls, which is moved up the canal about 150 feet, in order to lengthen and improve the level below. This change is necessary, and contemplated by both plans; no separate estimate of the cost consequent upon this change is made.

Act, chapter 213, Laws of 1849, provides as follows:

"§ 1. In rebuilding the locks on the Cayuga and Seneca canal, the Canal Commissioners are hereby authorized, if they shall deem the interests of the State to require it, to separate this canal from Seneca river, and construct an independent channel for the same, from the head of lock No. 9, below Seneca Falls, to the Montezuma level, crossing the Seneca river by an aqueduct, thereby dispensing with the rebuilding of three locks.

"§ 2. The expenses incurred under this act, shall be paid as directed by chapter 348, Laws of 1847."

By the authority conveyed in the foregoing law, the Commissioners have directed the necessary surveys and estimates to be made, in order to ascertain the feasibility of the proposed improvement.

The length of this improvement is about three and a half miles, and the estimated cost of the work, including the aqueduct over the Seneca river, is $128,877.37.

The estimates are for a canal of the ordinary size, except the estimate for the aqueduct, which is intended to conform to the dimensions of the enlarged canal.

By this improvement, three locks are dispensed with (No. 9, 10 and 11), and about three miles of difficult slack water navigation.

The payments are made as directed by the act, chapter 348, Laws of 1847.

Statement showing the cost of work completed, also the estimated cost at contract prices of work now constructing, the amount paid, and remaining to be paid to complete the work:

No. of lock.	Location.	Estimated cost at contract prices.	Amount paid.	Amount to be paid.
2 and 3.	Waterloo completed	$36,853 88	$36,853 88	
5, 6 and 7.	Seneca Falls, constructing	58,616 19	28,450 69	$30,165 50
		$95,470 07	$65,304 57	$30,165 50

Statement showing the estimated cost of rebuilding locks 8, 9, 10, 11 and 12, and raising the Seneca Falls dam and the towing-path, so as to dispense with the Chamberlain lock:

No. of lock.	Location.	Estimated cost.	Amount.
8.	First lock below Seneca Falls.....	$14,611 00	
9.	Second do do	11,683 00	
10.	River crossing..................	11,424 00	
11.	do	13,926 00	
12.	Cayuga Lake lock	14,659 00	
	Raising Seneca Falls dam, &c.	9,471 00	
		$75,774 00	
	Add for contingencies	7,500 00	
			$83,274 00

Locks on Champlain Canal.

No. of lock.	Location.	Kind of lock.	Condition.	Length from quoin to quoin.	Width in chamber.
No. 1........	Old Junction.........	Lift lock...	Old............	90	15
2........	do	do ...	Old............	90	15
3........	Mohawk river, s'th side	Guard lock.	Rebuilt.......	100	15
4........	do n'th side	do .	Old............	$90\frac{1}{3}$	15
5........	1st above Waterford..	Lift lock...	Rebuilt in 1842	100	16 1-6
6........	2d do do ..	do ...	do 1849	100	15 10-12
7........	3d do do ..	do ...	$\frac{1}{2}$ do 1844	99	14 9-12
8........	Flynn, do ..	do ...	do 1840	99 7-12	15 10-12
9........	Hewitt, do ..	do ...	Rebuilding....	100	15 10-12
10........	Becker's, do ..	do ...	Rebuilt in 1847	$102\frac{1}{3}$	13 9-12
11........	Saratoga dam.........	Guard lock.	do 1834	101	15 1-6
12........	do	do .	Partly rebuilt.	$101\frac{1}{4}$	$13\frac{1}{3}$
13........	Bassitt's.............	Lift lock...	Rebuilt in 1839	101	$15\frac{2}{3}$
14........	Fort Miller...........	do ...	do 1842	100	$15\frac{1}{2}$
15........	Moses' kill...........	do ...	do 1840	$101\frac{1}{3}$	$15\frac{2}{3}$
16........	Fort Edward..........	do ...	do 1837	100	15
17........	Fort Ann.............	do ...	do 1829	$101\frac{1}{3}$	$13\frac{2}{3}$
18........	do	do ...	do 1829	$101\frac{1}{2}$	$13\frac{1}{3}$
19........	do	do ...	do 1829	$101\frac{2}{3}$	$13\frac{2}{3}$
20........	Parish lock	do ...	do 1837	100	15
21........	Wood creek	Guard lock.	do 1845	100	15
22........	Whitehall............	Lift lock...	do 1829	100	$13\frac{2}{3}$
23........	do	do ...	do 1829	100	$13\frac{1}{3}$
24........	do	do ...	do 1829	100	$13\frac{1}{3}$
Wat'rford side cut........	Waterford............	....	....	....	....
No. 1........	do	Lift lock...	Partly rebuilt..	98	14
2........	do	do ...	do ..	98	13 9-12
3........	do	dc ...	do ..	98	13 9-12

N. B. The above measurements have been carefully made, and the dates of rebuilding the several locks ascertained as nearly as possible.

J. P. GOODSELL, *Engineer.*

Chemung Canal.

The work now in progress upon this canal, is by order of the Senate, in the hands of a select committee. It may therefore be considered improper to speak of it in this report.

All of which is respectfully submitted.

CHARLES COOK,
JACOB HINDS,
Canal Commissioners.

Minority report of the Canal Commissioners, in answer to resolution relative to projected plans of enlargement of canals, other than the Erie canal, on March 21, 1850.

To the President of the Senate:

In compliance with the following resolution,

"In Senate,
"*February* 12, 1850.

"*Resolved*, That the Canal Commissioners be requested to report to the Senate the plan or plans projected or adopted since the 1st of January, 1848, for the enlargement of any of the State canals, other than the Erie canal; or, of any channel, section, or portion of the same, now or hereafter to be connected therewith; whether by said plan or plans, connections with other navigable waters are to be discontinued, and to what extent; the location, length and cost, or estimated cost of each portion now under contract; the amount done and remaining to be done; the law by which authorized; and the fund out of which the cost of each is payable; also a description of the plan and estimates of the cost of rebuilding the several locks, except on the Erie canal, now under contract, of the original and of the enlarged size; the changes, if any, in their location, the cost of bringing them into use, resulting from such changes; the authority for the same, and the fund from which the cost is payable.

"By order.

(Signed) "W. H. BOGART, *Clerk.*"

The undersigned, one of the Canal Commissioners of this State, having had under consideration the resolution of the Senate above recited, and having seen the report of the majority of the Board of Canal Commissioners thereon, begs leave to dissent from said report, and to submit the following as the report of a minority of said Board of Canal Commissioners.

The undersigned has no means of ascertaining the amount,

kind or quality of work finished, in progress, or under contract, on the Chemung, Cayuga and Seneca, and Oswego canals, nor the estimated cost thereof, and is therefore unable to say whether the statements in said majority report on those subjects are true, and present to the Senate a fair and faithful exhibit of the extent of the aggressions on the guarantees of the Constitution or not. If the estimated amounts fall as far short of the actual cost as the past history of engineering in this State would authorize us to suppose, then we may safely double the figures of the majority report as the probable amount of the expenditures which will be required to complete the works now in progress of construction on said lateral canals. I shall not trouble the Senate with any unnecessary speculations, with regard to the propriety of commencing these works under proper circumstances; nor with regard to the economy manifested in their progress thus far; nor should I have troubled the Senate at all with any report on the subject, did I not believe that a great principle is involved in the legislation of the past two or three years, and the acts of the Commissioners under it, tending to the establishment of a policy which I deem highly reprehensible, to call it by no harsher name, and against which I feel bound to enter my solemn protest.

It is this: Is there power in the Legislature, or the Canal Commissioners, to apply a dollar of the canal revenue to the enlargement of any work not specifically provided for in the Constitution, until the guarantees of the Constitution to the public creditors are fully met and satisfied? Another change of canal policy is also involved in the action of the Canal Commissioners, of serious moment, although it is of secondary consideration to the great question of constitutional power.

It has, until within a few years, been the settled policy of the State, as a matter of economy and interest, to avail itself of the natural advantages of river navigation, wherever such advantages existed and might be improved by the State, as in the case of the Tonawanda, the Seneca, the Oswego, the Chemung and the Hudson rivers. Experience has demonstrated that river navigation, in connection with the canals, is a cheap, economical, safe and useful navigation; and after the lapse of a quarter of a century it is too late to urge that it is so useless, expensive or difficult, as to authorize a deeply indebted State to overleap all constitutional restraints to remedy the evil. The policy now in

vogue seems to be to cut loose from the streams heretofore employed as a part of the canals, to throw away the money expended in their improvement, and to dig new channels on the enlarged plan along their margin at a great expense, and, in my opinion, without any justification whatever for the change. This change has been made at Havana, and, as I think, without the slightest necessity for it; along the Seneca river, where I have been unable to discover any improvement was needed, except the rebuilding of a few locks; and at Oswego, where a half a million of money will be squandered in what are called *improvements*, which, from the limited knowledge I have in the matter, are as uncalled for as would be a ship canal along Long Island Sound. Some of the locks on the Oswego canal undoubtedly required to be rebuilt; and I do not question the propriety of rebuilding them on the enlarged plan, at all events, until the $100,000 appropriated to said canal should be exhausted in providing for the increased expense of the enlarged locks, beyond the cost of those of the old plan. This money, judiciously expended, would, in my humble opinion, have met all the wants of that canal until the time when the completion of the works provided for in the Constitution would have left the canal revenues free, to be applied to the entire enlargement of the Oswego canal. I also enter my protest against this new, and in my judgment, wasteful and profligate policy.

The serious question, however, is that of constitutional power; and I must be pardoned for devoting a brief space of time to the examination of this question, in order that my position as an officer of the State having charge of canals, may be clearly understood. If I remained silent, my silence might well be construed into my approval of what I deem to be wholly indefensible.

The provisions of the Constitution are clear, direct, and imperative. A mind not distorted by interest or hostility to the government of the State, and the will of the people, can see distinctly the path of duty which it marks out; and seeing this, its commands ought, and should be obeyed. It is no answer, morally or legally, to say that the 7th article is no part of the Constitution. That ground has been taken in high places; and what was understood to be the mandate of an administration, may have materially influenced the conduct, if not judgment, of a partizan Legislature. But I can never subscribe to the doctrine that I

am at liberty, either as a citizen, or an officer, to regard such portions of the fundamental law, as I may find an obstacle to my individual projects, as no part of the paramount law of the land, or to speculate on the probability of its adoption if it had stood alone, or a salvo to a foregone conclusion to disregard it.

The first section of the seventh article of the Constitution, declares that, "after paying the expenses of collection, superintendence and ordinary repairs, there shall be appropriated and set apart in each fiscal year, out of the revenues of the State canals, $1,300,000," etc., until the debt called the canal debt shall be wholly paid. The second section sets apart $350,000 out of the surplus revenues of the State canals for the payment of the General Fund debt. The third section is in these words: "After paying the said expenses of superintendence and repairs of the canals, and the sums appropriated by the first and second sections of this article, there shall be paid out of the surplus revenues of the canal to the treasury of the State, on or before the 30th day of September in each year, for the use and benefit of the General Fund, such sum, not exceeding $200,000, as may be required to defray the necessary expenses of the State, and the remainder of the revenues of the said canals shall, in each fiscal year, be applied in such manner as the Legislature shall direct, to the completion of the Erie canal enlargement and the Genesee Valley and Black River canals, until the said canals shall be completed."

It will be seen by an examination of these sections that the whole of the revenues of the State canals are from year to year specifically appropriated by the Constitution, and in this order of priority: 1st, to the expenses of collection, superintendence and ordinary repairs; 2d, $1,300,000 as a Sinking Fund to pay the debt known as the canal debt; 3d, $350,000 as a Sinking Fund to pay the General Fund debt; 4th, a sum not exceeding $200,000 to aid the General Fund in defraying the expenses of government; and 5th, all the remainder to the completion of the Erie enlargement, the Genesee Valley and Black River canals—"until the said canals shall be completed." This order of priority, and the true signification of the term "ordinary repairs" has become exceedingly interesting, if not important. Modern ingenuity, it is true, has discovered that ordinary repairs is a convertible term, and may, by a little legislative legerdemain, be

made to signify the enlargement of the lateral canals, and embellishing them with costly and magnificent bays, basins, and aqueducts—the constructing of new canals where none have heretofore existed—the changing the routes of the old lateral canals, and in short the entire engulfing, in the lateral canals, the remainder, which the people, in adopting the Constitution, vainly supposed they had sacredly pledged to the completion of the works which had been authorized by law, begun, and abandoned for want of funds.

Let us examine this modern doctrine a little farther. If the term, "*ordinary repairs*," can by possibility be tortured into an authority for enlarging a lock, or a rod of the *lateral canals*, what shall prevent a similar construction in favor of enlargement on the *Erie canal?* Enlargement means the same thing, as I understand it, on the Erie, Chemung, or the Oswego canals. It will be borne in mind that "*ordinary repairs*" has priority of all the constitutional appropriations of the canal revenues. If the term, "*ordinary repairs*," is so elastic as to be stretched over every species of enlargement, what becomes of the several Sinking Funds? Why not finish the Erie enlargement, and the Genesee Valley and Black River canals, before applying a dollar to the payment of the public debts? All that is required to accomplish it is a poetical flourish at the end of the act authorizing it, thus, "and the expenses thereof shall be charged to *ordinary repairs*."

Who cannot discover the utter fallacy of this abominable doctrine? Ordinary repairs has heretofore had a definite, well understood meaning, and was first as distinctive a term as *construction*, or Erie enlargement, until locality and private cupidity laid their unholy hands on the Constitution, and scattered its sacred guarantees to the four winds of heaven. The majority, it seems, rely on a statute passed in 1836, to justify the enlargement of the *locks* on the Cayuga and Seneca canal. Surely the majority must know that if that statute is inconsistent with the provisions of a Constitution adopted since its passage it is abrogated. It has become impossible to carry it into effect, and it has therefore ceased to be a valid or binding law, and it is so expressly declared in the 17th section of the first article of the Constitution of 1846. That act was *abrogated* by the Constitution, and cannot justify a diversion of the canal revenues to objects prohibited by that Constitution. The act authorizing the extension of the Chemung canal, and appropriating a

portion of the canal revenues under the very convenient misnomer of "*ordinary repairs*" to that object, was, in my opinion, clearly unconstitutional, and was a dead letter the moment it had passed through *the forms* of legislation, and should not, therefore, have been carried into effect. Much has been said of the acts and doings of officers of the State under what is claimed as authority granted by this statute. But as it is probable that all these matters will come up for investigation before a committee appointed by one branch of the Legislature of this State, I do not feel myself at liberty to refer more particularly to the acts of individuals; for I would by no means make myself obnoxious to the charge of wantonly or untimely assailing, or seeking to prejudice the position of any man. I am free to admit, however, that with my present understanding of that great and paramount law of the State, (the Constitution,) I should have felt myself at liberty to disregard the law in question, and by so doing have brought the statute, or my acts under or in regard to it, to the decision of the proper legal tribunal.

The act of 1849, authorizing the enlargement of the locks on the Oswego canal, under one of the multiform aspects of "*ordinary repairs*," is equally unconstitutional. The law, too, waiving this objection, only authorizes a change of the *location* of the locks, and the necessary section work to bring them into use. Now it appears that an entirely independent line of canal has been projected, and the old works of the State entirely abandoned, so far as the slack water navigation is concerned. This, I insist, is not contemplated by the statute, although it is drawn with consummate skill and ingenuity. If this plan of separating the canal from the river is carried out, I do not hesitate to predict that $2,000,000 of the canal revenues will be buried in the new line, under the convenient head of "ordinary repairs!" In my judgment it is not advisable that this separation should take place.

If my views of the Constitution are correct, then these lateral works must stop where they are. It is no more competent for this Legislature to continue an unconstitutional work, than it was for the last Legislature to commence it. Not a dollar of canal revenues can be appropriated to this object without doing violence to the plainest and most sacred pledges of the Constitution; nor can they be resumed until "the Erie enlargement, the Genesee Valley and Black River canals are completed."

It is signally unfortunate that the expressed will of the people should not have been obeyed. Daily loud complaints are uttered, because the capacity of the Erie canal is not adequate to the demands of a rapidly growing commerce. Portions of it are enlarged, while other portions are not, opposing serious obstacles to its usefulness. It is the aorta of the canal system, bearing the lifeblood of commerce from its most distant ramifications through its now impeded channels, and it can ill bear the gross robbery of the aliment upon which it had a constitutional right to depend for an increase of its capacity. It is idle to say that the Chemung, or Cayuga or Seneca canals were not fully adequate to all the demands of commerce upon them. Their enlargement was not needed, and it was unconstitutional to do so. The Oswego would have been content with enlarged locks, and the $100,000 would have secured this improvement. All beyond this, in my estimation, was wrong.

It remains to be seen whether farther provision for these works is to be made under the specious cover of "ordinary repairs." If such shall be the result, I shall have the proud satisfaction of knowing that my earnest protest is recorded against it.

Respectfully submitted.

FREDERICK FOLLETT.

Size of prism and supply of water—Western Division.

The following is the report of Henry Tracy, Esq., on this subject, and referred to in reports of Commissioners in 1849:

Report of the Canal Commissioners as to the supply of water between Tonawanda and Montezuma.

CANAL COMMISSIONERS' OFFICE,
January 28, 1850.

To the President of the Senate:

In compliance with the following resolution:

"IN SENATE, *January* 26, 1850.

"*Resolved*, That the Canal Commissioners report to the Senate what action has been had by them in relation to the supply of water for the Erie canal between Tonawanda and Montezuma.

"By order: WM. H. BOGART, *Clerk*."

The Canal Commissioners report:

That in June last, Henry Tracy, Esq., a civil engineer, was employed to examine and report upon the subject of a supply of

water for the Erie canal from Buffalo to Montezuma, to be drawn from the Tonawanda creek and Lake Erie.

The only action had by the Commissioners, except the directions to Mr. Tracy, has been to determine upon the size of the prism of that portion of the canal between Lockport and the Tonawanda creek, upon which no work had been done previous to the suspension of the public works in 1842. To pass the requisite quantity of water for the supply of the canal, east as far as Montezuma, it has been determined to make that portion of it 100 feet wide upon the surface, by eight feet in depth, with banks sloping $1\frac{1}{4}$ feet horizontal, to one foot vertical rise.

Whenever it is necessary to fix upon the size of the prism east of Lockport, the examinations already made will enable the Commissioners to do so by a comparison of the report herewith submitted with others heretofore made upon the same subject.

Respectfully submitted.

CHARLES COOK,
FREDERICK FOLLETT,
JACOB HINDS,
Canal Commissioners.

Report.

To the Hon. the Canal Commissioners
of the State of New York.

Gentlemen: According to your instructions, I have made the necessary examinations of the route for the Erie canal enlargement between Tonawanda creek and the Montezuma level, for the purpose of ascertaining the proper size of the water way, and the inclination of surface required, so as to supply it exclusively from the water of Lake Erie and Tonawanda creek; the canal to be adapted to a trade of 200 lockages a day.

And I beg leave to submit the following.

HENRY TRACY, *Civil Engineer.*

Albany, *Dec. 27th*, 1849.

Report on the proper size, plan, and surface inclination for the Erie Canal enlargement, between the Tonawanda creek and Montezuma.

In order to ascertain the proper size and inclination for this part of the canal, it becomes necessary to determine,

1.

The quantity of water required for the canal.

2.

The maximum velocity for the current.

3.

The rule by which its inclination should be calculated.

4.

The effect of aquatic plants in retarding the current, &c.

1.

The quantity of water required for this part of the canal.

This is given at length in a report of the undersigned to the Canal Board, dated the 17th instant, to which he begs leave to refer. The amount of water required, is (in that report) given as follows, viz.:

	Cubic feet a minute.
*Leakage, waste and evaporation	24,000
†Lockage water	2,959
Swelling boats out of locks	740
Leakage of double locks	2,400
Total	30,099

Say 31,000 cubic feet a minute.

The quantity required to pass different points on the canal, will be as follows, viz.:

Pendleton	31,000
Lockport	29,600
Rochester	17,000
Last lock at Clyde	6,100

2.

The proper velocity at which the water should move.

The canal tonnage going east (down tonnage,) is about five times as great as that going west, (up tonnage,) hence a slight current in the canal favoring the descending trade, will do no injury, but rather be a benefit. This current, however, should not be so strong as to require more force to draw a boat west with a light, than east with a heavy load.

‡ The ordinary velocity at which canal boats are towed,

* The distance is 120 miles; improvements have been proposed which will shorten the route, but probably will not materially affect the amount of water.

† This is for an average trade of 200 lockages a day, which will at times require the passage of 400 boats a day.

‡ Two horses are used for towing freight boats. The boats now in use weigh from 25 to 35 tons; a full load is from 65 to 85 tons. The boats for the enlarged canal will carry from 150 to 200 tons.

(exclusive of the current,) is about two miles an hour. With a mean current of from one-third to one-half a mile an hour, (varying according to the shape of the boat, &c.,) the force required for towing a loaded boat at this velocity, (exclusive of the current,) to the eastward, will be about the same as that required to draw the same boat with one-fifth of a load westward (against the current) at the same velocity.

This current will to some extent hinder the passage of loaded boats going west, yet against it they can be drawn at from $1\frac{1}{3}$ to $1\frac{2}{3}$ miles an hour.

Hence it has been deemed proper to fix the greatest velocity for the mean current at half a mile an hour. This gives a surface velocity of about $\frac{5}{8}$ of a mile an hour. Any velocity greater than this will offer obstructions to the trade.

3.

The rule by which the inclination should be calculated.

Though much has been written on the theory of hydrodynamics, yet the formula of Prony is the best at present known for calculating the velocity of water in rivers and canals, when we have given their size and the inclination of their surface.

The formula is as follows, viz:

$$V=\frac{1}{2\,b}\left\{(4\;b\;I\;D+a^{2})^{\frac{1}{2}}-a\right\}$$

In which V = the mean velocity in feet a second.

I = the sine of the inclination of the surface.

* D = the hydraulic mean depth in feet.

The constants *a* and *b* were determined by experiments made by Prony as follows, viz:

$$a=0.0000444499$$
$$b=0.0000942772$$

and later, by a more numerous set of experiments made by Eytelwein, as follows, viz:

$$a=0.0000242651$$
$$b=0.0001114155$$

The formula gives merely an approximation to the truth for open canals of small size quite correct, but for waterworks like those of New York and Boston, having smooth channels, it is necessary to use other values for *a* and *b*.

* The hydraulic mean depth is the quotient of the area of the cross section of the water way, divided by that part of its perimeter below the surface of the water way.

The results calculated according to the different constants a and b, of Eytelwein and Prony, vary as follows, using the same values of $I\ D$, for each.

Value of $I\ D$, in feet.	Velocity in feet a second. Eytelwein.	Prony.	Dif. per cent.
0.00000931	0.20	0.16	20
0.00001731	0.30	0.25	17
0.00002753	0.40	0.35	12
0.00003999	0.50	0.46	8
0.00005467	0.60	0.56	7
0.00007158	0.70	0-66	6
0.00009072	0.80	0.77	4
0.00011209	0.90	0.88	2
0.00013568	1.00	0.99	1
0.00016150	1.10	1.09	1

The velocity of half a mile an hour, or forty-four feet a minute, is equal to 73-100 of a foot a second.

By an inspection of the above table, it will be seen that at this velocity the constants of Prony give results differing about five per cent. from those of Eytelwein.

The safest plan will be to use the rule of Eytelwein to determine the low water mark, and that of Prony for the high water mark.

4.

The effect of aquatic plants in retarding the current.

On the Western Division of the canals, much obstruction is offered to the flow of water in the canal by various species of pond weed (potamogeton) and other aquatic plants. These plants, in the summer months, cover nearly the whole bottom and sides of the canal between Lockport and Brockport. They commence growing as soon as the water is warm (generally in the month of June), and some varieties will rise to the surface in ten or fifteen feet depth of water. They are propagated both by seeds and root. Originally, they seem to have been brought by the current from Tonawanda creek (but are found in most of the small lakes and streams of western New York), and gradually increasing; there is reason to expect that in a few years the whole division will be covered with them.

By an ingenious contrivance* of Commissioner Hinds, these grasses can be cut and removed; but their growth is so rapid

* A sort of under-water scythe.

during the months of July and August, that it is necessary to cut them every few days. At the approach of cold weather and frost the whole disappear. Even when well cut, the stubble of this grass offers considerable resistance to the motion of the water.

Size of water way, and plans for the canal.

Dividing the number of cubic feet of water a minute required to pass different points, by the velocity in feet a minute (44), we have the water way required, as follows, viz:

At Pendleton	705	square feet.
At Lockport	673	do
At Rochester*	386	do

Nine miles west of Rochester, the water way of the ordinary size (viz., 429 square feet) will be required to pass the water at the velocity of 44 feet a minute.

Hence there is a necessity of making a greater water way than ordinary for the canal between this point and the Tonawanda creek.

East of Rochester, the water way remaining the same size as ordinary, (viz., 429 square feet,) the velocity will generally decrease to the last lock.

Plans proposed for the increased size of water way.

In making the plans, it has been thought best to use the ordinary side slopes, of $1\frac{1}{4}$ horizontal to 1 vertical, in earth work for the canal prism, (to be protected with slope walls,) and of 2 horizontal to 1 vertical for outside slopes in excavation and embankment. In rock, the cuts to be vertical.

1. From Tonawanda creek to the head of the Lockport locks (about 7 miles in length.)

The mitre sill of the guard gates near Pendleton is about 8 feet below the surface of low water; hence it is best to make the canal but 8 feet deep between the guard gates and Tonawanda creek; with this depth will be required 100 feet in width of surface, and 80 feet bottom width. East of these guard gates two plans are submitted, viz: Nos. 1 and 2. See annexed profile.

By plan No. 1 the canal will be 80 feet wide on the surface, $53\frac{3}{10}$ feet wide on the bottom, and $10\frac{1}{2}$ feet deep in the earth

* The Rochester aqueduct has a water way of but 304 square feet in the narrow part (when seven feet in depth). The velocity in the aqueduct will therefore be fifty-six feet a minute.

work, (about 2½ miles,) 62 feet wide and 12 feet deep in the rock, (another 2½ miles.)

Plan No. 2 contemplates making the canal 100 feet wide and 7 feet deep. This plan will cost about $450,000 more than plan No. 1.

Plan No. 1 is believed to be far the best as well as the cheapest.

If constructed on this plan the flow of water at Lockport can be entirely controlled, even in time of the disturbance caused by rapid locking, grass, &c., without interfering with the navigation.

2. From the foot of the locks at Lockport to Rochester, (63 miles.)

As there is no lock on this distance, it has been thought best to make the towing path and berme banks so as to allow of raising the water from 2¾ to 3 feet higher at Lockport, during the obstructions caused by the grass, than will be required when these do not exist.

Four plans have been prepared for this part of the canal, (see annexed plans, profiles Nos. 1, 2, 3 and 4.)

Plan No. 1.

The canal to be of the ordinary width on bottom, with such depth and surface inclination as may be necessary to pass the water at a mean velocity of half a mile an hour.

Plan No. 2.

The canal to be of the ordinary depth, with such width of water way as may be necessary to pass the water at the same velocity.

Plan No. 3.

The canal to be eight feet deep for the first forty miles east of Lockport, and from thence gradually decreasing in depth to Rochester.

The water way on the western portion being made, in part, by increased width.

Plan No. 4.

The canal to have the bottom level between Lockport and Rochester, (the same level as the Rochester aqueduct,) and to have such depth at Lockport, as to give sufficient inclination to the surface to pass the required amount of water.

The principal dimensions of these plans are given in the following table, showing the size proposed for the Erie canal enlargement at Lockport, and the fall in the surface between Lockport and Rochester:

PLAN No.	In time of low water. Depth.	Width of bottom.	Surface.	Fall in surface.	In time of high water. Depth.	Width of surface.	Fall in surface.
1	10.30	52.5	78.25	3.82	13.00	85.0	6.52
2	7.00	87.5	105.00	4.30	10.00	112.5	7.30
3	8.00	74.0	94.00	3.86	11.00	101.5	6.86
4	10.41	52.5	78.52	3.41	13.20	85.0	6.20

The size east of Rochester to be the same used on other parts of the canal, viz.: 70 feet surface, 52½ feet bottom width, and 7 feet in depth.*

The cost of the different plans will be about the same, if proper care be taken in selecting the routes. It is however thought that the greater width of canal, according to plans Nos. 2 and 3 will increase the cost of culverts and bridging, so as to make those plans the most expensive.

The cost of this part of the canal, will be from 25 to 35 per cent. more, on account of the increase in the size of its water way, than it would be if constructed of the same size as ordinary canal.

Constructed on plans 2 or 3, it would be necessary to pass at all times nearly the same amount of water that is generally required. For if this, by some accidental cause does not happen to be done, the surface will soon approach a level, so as to leave less than 7 feet in depth at the western termination.†

By plan No. 4, not only will this difficulty be obviated, but also in case of a break west of Rochester, the canal may for a few days, (while the break is repairing,) be supplied from the Genesee Valley canal.

This is practically impossible by either of the other plans.

Hence, in view of all the circumstances of the case, it is deemed best to adopt plan No. 4, subject to such modification as may be necessary, on a final location, to suit the features of the route; the general plan being to have the bottom of the canal level with floor of the Rochester aqueduct, and to have the tow-path and berme banks raised high enough at Lockport, to be able, when necessary, to give the water surface an inclination sufficient to send eastward the amount required in time of the obstructions caused by aquatic plants, &c.

* See report of Canal Commissioners, Senate Doc. No. 30, for 1849.

† See report of O. W. Childs, Esq., Chief Engineer, dated 30th December, 1847. Ass Doc. No. 16, for 1848.

From Rochester to the Montezuma level.

It has been found on the Erie canal that occasionally crowds of boats collect above the locks, and acting as a sort of a dam, materially hinder the passage of water (to the locks,) so as to effectually prevent the rapid locking of boats. In order to obviate this difficulty, it is recommended that at the head of each lock, the canal be made $1\frac{1}{2}$ feet deeper than ordinary for the first quarter of a mile, and that the bottom in the next mile gradually rise to the ordinary level.

This will add a small amount to the cost of the canal, but will be a great benefit to, and materially increase its capacity, doing away to a great degree with the detentions caused at the locks.

The first 20 miles east of Rochester should be constructed with a surface inclination of half an inch to a mile.

The next 20 miles with one-third of an inch per mile of surface inclination.

The remainder of the distance with an inclination of about $\frac{1}{5}$ of an inch per mile.

The tow-path and berme should be raised high enough to be able to double these inclinations of the surface, wherever it may be necessary.

On the short levels it is practically of no consequence to allow for these slight inclinations in the construction of the canal. But when a level is more than four or five miles in length, they should be taken into account.

If the canal be constructed on this plan, it is believed that the necessary amount of water for its use will be entirely under control, and that there will be no difficulty at any time to supply the enlarged Erie canal between Tonawanda creek and the Montezuma level, with the water of Lake Erie.

All of which is respectfully submitted.

HENRY TRACY,
Civil Engineer.

Albany, *December* 27, 1849.

Note.—In this report I have made no mention of the water of Oak orchard creek feeder. This is only a small amount (last summer being but 800 cubic feet a minute) and is thrown in for additional contingencies.

Mr. O. Allen, from the committee on canals, to which was referred so much of the Governor's message as relates to the completion of the State canals, submits the following report :

The Governor's message, after very ably illustrating the necessity and policy of an early completion of the State canals, and referring to the Constitution, which restrains the Legislature from borrowing money, suggests several methods for securing the means to complete the canals at an early day.

Will the proposed fund be sufficient and certain?

To ascertain whether it will be *sufficient*, we will inquire as to the extent of the draft that will be made upon it.

To determine whether it will be *certain*, we will examine the nature and extent of the revenues from which it is proposed to be accumulated.

By the very able report of the State Engineer, it appears that it will require, to complete the enlargement of the Erie canal, the Genesee Valley, and Black River canals, as follows:

The cost of completing enlargement work under contract, not done		$1,822,183 17
Estimated cost of work not under contract:		
Eastern Division	$2,119,146 04	
Middle Division	856,996 62	
Western Division	4,712,005 62	
		7,688,148 28
To complete the Black River canal		388,888 00
To complete the Genesee Valley canal		608,922 00
Total cost		$10,508,141 45

1. Of the capacity of the enlarged canal to *carry*, as compared with the present canal:

The small canal admits boats 78 625-1000 feet long, 14 46-100 feet beam, and 3 5-12 feet draught. Their average capacity is 79 63-100 (say eighty) tons.

The large canal admits boats 98 feet long, 17 5-12 feet beam, and 6 5-12 feet draught. Their capacity is 224 tons.

The proportion of down to up freights being as four to one, the average loads each way cannot exceed 50 tons for the small, and 140 tons for the large boats.

It appears from the reports of the State officers that no more than 52,000 lockages, on the average, can be made per season. 52,000 lockages of 50 tons each is 2,600,000 tons, which is the maximum capacity of the present canal *to carry*. 52,000 lock

ages of 140 tons each is 7,280,000 tons, which is the capacity of the enlarged canal *to carry.*

The relative capacity to carry, therefore, between the large and small canal is about as three to one. The total movement upon the canals for the past season was equal to 2,454,233 tons, producing $3,484,568 in tolls; 2,600,000 tons, which is the maximum capacity of the present canal, would produce at same rates $3,692,000, while 7,280,000 tons, which will be the maximum capacity of the enlarged canal, would produce at same rates the enormous sum of $10,337,600.

2. Of the capacity of the enlarged canal to *compete* with rival routes by cheap transport:

The cost of towing a small boat on the present canal, at the rate of two miles per hour, is proved by the experience of forwarders for twenty-five years to be fourteen cents per mile, and the expense of officers and crews, &c., eleven cents per mile. Take the total cost of keeping the canal in repair and divide it by the number of miles boats are moved, and it shows that the repairs of the canal are equal to 6 5-10 cents per mile movement. The total estimated annual depreciation of boats upon the canal, divided by the number of miles of movement, is equal to 13 7-10 cents per mile.

Cost of towing per mile	14	cents.
Cost of officers and crew per mile	11	do
Repairs of canal	6 5-10	cts.
Depreciation of boats	13 7-10	cts.
Total cost	45 2-10	cts.

per mile for moving a small boat carrying 80 tons down freight, or 5 65-100 mills per mile, equal to $2.05 6-10 per ton from Lake Erie to tide water, 364 miles. Nine and a quarter barrels of flour being equal to one ton, the cost of moving a barrel of flour is 61-100 mill per mile, and 22 2-10 cents from Lake Erie to Albany, 364 miles.

It has been assumed that the cost of towing the large boats upon the enlarged canal, as compared with the small boats upon the present canal, will be as the area of a transverse section of the large to the small boat. It is mathematically certain that the ratio cannot be less, and we will show that it is decidedly more favorable to the large boat.

14 46-100 feet beam and 3 5-12 feet draught give the area of the transverse section 43 38-100 square feet for the small boat.

17 5-12 feet beam and 6 5-12 feet draught give the area of the transverse section 105 square feet for the large boat.

If to move 43 38-100 one mile, at the rate of two miles per hour, requires 14 cents, to move 105 one mile at same rate will require 33 88-100 cents.

This result would be mathematically certain if the circumstances of the movement of the large and small boats were identical, but they are not. There are elements not observed in the above calculation, which are greatly favorable to the large boat and canal.

A boat moved upon a narrow water way meets with great resistance from the movement of the water to replace that which has been displaced by the passage of the boat. This resistance is greatest where the water way is smallest, as compared with the area of the transverse section of the boat, and diminishes as the difference between the areas of the water way and the boat increases.

It follows that the motive power required to move a craft at any given rate of speed is seriously affected by the existing proportion between the areas of the transverse section of the water way and the boat, upon the respective canals.

The present canal is 40 feet wide at water surface, and 28 feet at bottom; mean width 34 feet, depth 4 feet, showing the area of the transverse section to be 136 square feet. Area of small boat 43 38-100 square feet. Area of small canal to area of small boat about three to one.

The enlarged canal is 70 feet at water surface, 52½ at bottom, mean width 61¼ feet, showing the area of the transverse section to be 428¾ square feet.

Area of large canal 428¾. Area of large boat 105, or about four to one.

The motive power required to move the small and large boats do not, therefore, bear the same proportion as the areas of the transverse sections of the respective boats. But the advantage is decidedly in favor of the large boat and enlarged canal, arising from the larger relative dimensions of the water way.

The per cent. of this advantage is not susceptible of mathematical demonstration, *but experience proves the value of it*, as it is

found operating upon the movement of large boats in the large canal.

Upon the present canal, boats are moved *by two horses*, at the average rate of two miles per hour. Long experience has proved that to be the economical rate of speed. It is proved also, by actual experiment with both classes of boats, that the large boats upon the enlarged canal are economically moved at the same rate of speed by *three horses*. Though the addition of the third horse does not in fact increase the towing charges fifty per cent., it is assumed for the purposes of this comparison that fifty per cent. is added to the towing expenses.

Experience proves that the cost of officers and crew, &c., are the same upon the large and the small boat.

The cost of movement of large boats upon the enlarged canal is:

Cost of towing per mile	21	cents.
do officers, crew, &c	11	do
Repairs of canal	6.5	do
Depreciation of boats	13.7	do
Total cost	52.2	do

per mile for moving a large boat, carrying 224 tons, down freight, or 84 8-10 cents per ton from Lake Erie to tide water, 364 miles; equal to ¼ mill per mile upon a barrel of flour, or 9 1-10 cents from Lake Erie to tide water, 364 miles.

Railroads.—The cost of transporting freights upon railroads is shown by the report of the State Engineer to be 8 mills per ton per mile, equal to 86-100 mill per mile on a barrel of flour.

These amounts of cost, both upon the canals and railroads, represent all elements of actual expenditures, including the repairs of the several works and the depreciation of property, but excluding interest upon investment and profits, tolls and dividends, except that in the case of the canals, the amount charged to repairs is derived from the tolls.

The following tabular statement will show in juxtaposition the dimensions and capacity of the large and small boats, the relative cost of transportation towards tide water upon the enlarged and present canal and railroads, exclusive of tolls, dividends, or profits:

TABLE

Showing the relative dimensions and capacity of boats, the cost of moving freight towards tide water on the present canal, enlarged canal, and upon railroads.

	Small boats.	Large boats.	Railroads.
Length of boat	$78\frac{625}{1000}$ feet.	98 feet.	
Beam	$14\frac{46}{100}$ do	$17\frac{5}{12}$ feet.	
Depth of draught	$3\frac{5}{12}$ do	$6\frac{5}{12}$ feet.	
Burden	80 tons.	224 tons.	
Cost of towing per mile	14 cents.	21 cents.	
Cost of officers and crew	11 cents.	11 do	
Repairs of canal	$6\frac{5}{10}$ cents.	$6\frac{5}{10}$ cents.	
Depreciation of boats, &c	$13\frac{7}{10}$ cents.	$13\frac{7}{10}$ do	
Boat, total cost per mile	$45\frac{2}{10}$ cts. $91 for 80 tons.	$25\frac{2}{10}$ cts. $116 on 224 tons.	
Cost per ton per mile	$5\frac{65}{100}$ mills.	$2\frac{1}{3}$ mills.	8 mills.
Cost per ton for 364 miles	2.05\frac{6}{10}$	$84\frac{8}{10}$ cents.	
Cost per bbl. flour per mile	$\frac{61}{100}$ mill.	$\frac{1}{4}$ mill.	$\frac{86}{100}$ mill.
Cost per bbl. flour for 364 miles	$22\frac{2}{10}$ cents.	$9\frac{1}{10}$ cents.	

Railroads.

From Buffalo to Albany.		
Cost per ton for 325 miles	$2	60
do bbl. flour, same		28
From Dunkirk to New York.		
Cost per ton for 445 miles and ferry	4	02
do bbl. flour on same		43½
From Ogdensburgh to Boston.		
Cost per ton for 400 miles	3	20
do bbl. flour on same		34½
From Buffalo to Boston.		
Cost per ton for 525 miles	4	20
do bbl flour for same		45
From Albany to Boston.		
Cost per ton for 200 miles	1	60
do bbl flour, same		17

Flour in barrels, from its weight, bulk, and value, is deemed a fair representative of canal freights.

In the following comparison, therefore, of the relative cost of transportation, exclusive of tolls, dividends or profits, the cost of carrying flour will be used. This camparison of routes is made for the purpose of illustrating the *capacity* of the enlarged canal *to compete* by cheap transport.

We give the cost of carrying flour from a common point at the west, say Detroit, to the cities of Boston and New York, by the several routes. The prices of lake freight being the average prices actually paid, which includes the profits, and in the case of the Ogdensburgh route, it includes Welland canal tolls.

1. From Detroit to Boston, by way of Ogdensburgh:

Detroit to Ogdensburgh, lake freight	30	cents.
Ogdensburgh to Boston	34½	do
Total	64½	do

By way of Buffalo.

Detroit to Buffalo, lake freight	12	do
Buffalo to Boston, railroad	45	do
Total	57	do

Detroit to Buffalo, lake freight	12	cents.
Buffalo to Albany, canal	9.1	do
Albany to Boston, railroad	17	do
Total	38.1	do

Ogdensburgh route to Boston	64½	do
Canal route	38.1	do
In favor of canal route	26.4	do

Centre railroad route	57	do
Canal route	38.1	do
In favor of canal route	18.9	do

2. From Detroit to New York, by way of New York and Erie railroad :

Detroit to Dunkirk, lake freight	12	cents.
Dunkirk to New York	43½	do
Total	55½	do

By way of Buffalo

Detroit to Buffalo, lake freight	12	do
Buffalo to Albany, railroad	28	do
River charges	8	do
Total	48	do

Detroit to Buffalo, lake freight	12	do
Buffalo to Albany, canal	9.1	do
River charges	8	do
Total	29.1	do

Dunkirk route	55½	do
Centre railroad route	48	do
In favor of Centre railroad route	7½	do

Centre railroad route	48	cents.
Canal route	29.1	do
In favor of canal route	18.9	do
Dunkirk route	55½	do
Canal route	29.1	do
In favor of canal route	26.4	do

An examination of the statistics of population of the States of the Mississippi valley will illustrate in a striking manner the difference in the rate of increase of the free States, which carry on their trade chiefly through our channels, and the slave States which trade chiefly with New Orleans.

The population of the following States in the following years was,

States.	1800.	1810.	1820.	1830.	1840.
Ohio	45,365	230,760	581,484	937,903	1,519,407
Indiana	4,875	24,520	147,178	343,031	685,866
Illinois		12,282	55,211	157,445	475,183
Michigan		4,762	8,896	31,639	210,267
Wisconsin					43,112
Iowa					30,945
	50,240	272,324	792,796	1,470,018	2,964,780

The increase from 1800 to 1840 was 5,801 per cent., or 145 per cent. per year. The increase from 1830 to 1840, was 102 per cent., or over 10 per cent per year.

The population of the following States was, at the same periods, as follows:

States.	1800.	1810.	1820.	1830.	1840.
Kentucky	220,955	407,511	564,317	687,917	779,828
Tennessee	105,602	261,727	422,813	681,904	829,210
Mississippi	8,850	40,352	75,448	136,620	375,664
Louisiana		79,566	153,407	215,739	352,411
Missouri		20,845	66,586	140,455	383,702
Arkansas		14,483	30,388		97,574
	335,407	824,484	1,312,959	1,862,635	2,818,389

In these States the increase from 1830 to 1840 was 51 per cent., or 5 13–100 per cent. per year. In the north-western

States, 10 per cent. per year for the same, while in the Union, from 1800 to 1840, it was 6 7–10 per cent. per annum only.

The population of the eastern and northern States are becoming more and more occupied in manufactures, and therefore produce a constantly decreasing ratio of agricultural products, and look more and more to the west to supply that deficiency.

From data and calculations which it is not necessary here to state, it appears that the increase of capital and wealth, or money and commodities compared with population, is as 50 to 31. (Say 5 to 3.)

The north-western States having increased in population 102 per cent. in 10 years, or $10\frac{1}{5}$ per cent. per year, the products of these States will have increased in the same period 167 per cent., or nearly 17 per cent. per year, and though the eastern and northern States have not, during the same period, increased in population at an equal ratio, yet by reason of the immensely productive power of machinery in these States, the increase in wealth and products have been equal, if not beyond, the rate of the western States.

The following table shows the amount expended each year, from 1826 to 1850, inclusive, for repairs upon all the canals. The aggregate expenditures and the average annual expenditure:

1826	$182,162
1827	232,472
1828	234,483
1829	254,433
1830	221,005
1831	180,773
1832	344,917
1833	372,789
1834	478,964
1835	432,105
1836	406,122
1837	492,144
1838	481,824
1839	379,769
1840	460,686
1841	357,820
1842	452,559
1843	383,076
1844	464,384
1845	520,452
1846	510,355
1847	496,421

1848	$647,826
1849	521,130
1850	611,038
Total	$10,146,709

Average annual expenditure, $405,868.

Average annual expenditure for repairs	$405,858
Annual expenses of collection	70,000
Average annual expenditure for 25 years past	$475,868

STATEMENT,

Showing the total amount of money expended by the Canal Commissioners on the enlargement of the Erie canal to the 30*th September,* 1850, *with the interest on the same at the rate of six per cent. per annum, to* 1*st of April,* 1854 ; *interest compounded semi-annually, the total interest together with the total expenditure and interest, including no part of the cost of the original construction.*

YEAR.	Amount expended.	No. of years.	Interest at 6 percent.
1835	$31,810 70	18½	$63,074
1836	53,218 83	17½	96,416
1837	636,312 17	16½	1,050,106
1838	1,163,196 12	15½	1,742,700
1839	2,237,785 74	14½	3,031,986
1840	3,234,749 66	13½	3,945,747
1841	2,518,309 72	12½	2,751,253
1842	1,521,152 51	11½	1,479,321
1843	530,801 54	10½	456,171
1844	418,692 06	9½	315,191
1845	155,130 43	8½	101,191
1846	70,012 35	7½	39,012
1847	62,331 30	6½	29,183
1848	634,573 08	5½	243,676
1849	1,000,323 97	4½	304,699
1850	1,365,695 00	3½	313,836
	$15,634,095 18		$15,963,562

Total expenditure	$15,634,095 18
Total interest	15,963,562 00
	$31,597,657 18

In order to remove all doubt as to the constitutionality of the bill, the chairman of your committee addressed a note to the Hon. John C. Spencer, submitting to him the plan, asking his opinion thereon. His answer is subjoined, together with the concurrence of Samuel Stevens and Daniel Lord, Esquires, which it is believed is conclusive on that point.

ORLANDO ALLEN,
JOHN J. TOWNSEND,
CALEB LYON, of Lyondale,
ALEXANDER GRAHAM.

Progress of the Canals in 1851.

The following extratsc, in relation to the completion of the enlargement of the Black River and Genesee Valley canals, are taken from the report of Mr. O. Allen, chairman of canal committee: (See pages 317 to 327 inclusive.)

Act for completing the enlargement of the Erie, Black River and Genesee Valley canals, passed July 10, 1851, and appropriated (provided the work should not exceed 10 per cent.) the sum of $10,508,141. Pending its passage, April 9, the Attorney General, Mr. Chatfield, declared in the following language its provisions unconstitutional: "I have examined all the provisions of this bill, which the time allowed me by the Senate has permitted, and I have come to the conclusion, unhesitatingly, that the whole scheme is a direct, open, and palpable infraction of the Constitution."

Daniel Webster (in answer to a majority of the Senate canal committee) decided that in his opinion, "on the whole, the bill was not in any of its provisions repugnant to the Constitution of New York." This decision was made April 11, 1851.

Tolls on railroads were abolished by act, July 10, 1851.

Report of the Canal Commissioners, in answer to a resolution from the Senate in relation to size of canal east Syracuse.

STATE OF NEW YORK:
CANAL DEPARTMENT,
ALBANY, *July* 3, 1851.

To the Honorable the Senate:

In answer to the following resolution the Canal Board respectfully report:

"In Senate, *April* 14, 1851.

"*Resolved*, That the Canal Board is requested to report, with as little delay as possible, whether any, and what plan has been adopted or formed for increasing the size of the enlargement of the Erie canal, or any part or section thereof, between Buffalo and Syracuse, beyond the width of seventy feet, and what part, if any, is contemplated to be increased in size; and also, to report to the Senate copies of all resolutions adopted by said Board since January 1, 1850, relating to increasing the size of any part of the enlargement beyond the width of seventy feet; and also, copies of all resolutions adopted by said Board since July 1, 1850, relating to the lengthening the locks on the Montezuma level."

On the 20th July, 1848, the Canal Board resolved to enlarge the Erie canal from the Erie avenue, in the city of Buffalo, to the north-westerly termination of section No. 3, being 9,930 feet in length, to eight feet depth of water, and one hundred and fifty feet wide at top-water line.

When this resolution was adopted, no plan had been fixed upon for passing Black Rock harbor, nor is it yet settled whether the navigation shall continue as it is, or an independent canal be made to pass this point. It is the opinion of many of the navigators on the canals, and of almost all the fowarders, that the enlargement should pass this harbor by an independent canal. Indeed it is esteemed by many as the only safe method of making a perfect navigation on this part of the canal; and it is believed by them that true economy will be promoted by its construction.

An examination of the annual reports of the Canal Commissioners, from the first opening of the navigation of this canal down to the present time, shows that the repairs upon this harbor have been exceedingly large, and that each succeeding year has increased them, and developed a fact, that if the navigation is continued as at present, under-water excavators must be continually employed to take out the alluvial deposits, in order to maintain a depth of seven feet water.

The attention of members of the Senate is respectfully called to the history of the navigation. and the repairs at this harbor, as set forth in the annual reports of the Canal Commissioners.

It appears that the difficulties attending the maintenance of the navigation at this harbor, have been steadily increasing from

year to year, and it has become an important question with regard to the enlargement, how they are to be overcome.

It is well known that the surface of the lake has, more than once, fallen below the level adopted for the canal, which is supposed to be, beyond a doubt, below the most extreme low water mark. This, connected with the fact that the canal from Pendleton to Montezuma is to be fed from Lake Erie through this portion of the canal, is another consideration in favor of the independent line, because by it a higher head may be obtained.

It was evident to the Board that, if the independent line should eventually be adopted, that the large volume of water required to maintain the navigation of 159 miles of the enlarged canal, would, under the circumstances—to wit, the slight declivity in the canal between Buffalo and Tonawanda, and the crowded navigation at this important terminus—render necessary a large and spacious channel between those places, and especially for that portion described in the above resolution, because of the great number of boats that will necessarily seek business therein, and lie, while loading, as obstructions to the passage of the water.

Besides this, the enlargement of the Erie canal is for no temporary period, and ample accommodations should be provided at all important points, to enable its business to be done with the utmost dispatch, and at the least possible expense.

On the 22d of September, 1849, the Board of Canal Commissioners "*Resolved*, That the enlarged Erie canal between Tonawanda creek and the guard lock west of Lockport, be constructed one hundred feet in width at top water line, with slopes in the prism of one and a quarter feet horizontal to one foot vertical, and eight feet depth of water."

Under this resolution, the Commissioners put 146 chains of the canal, to wit, sections Nos. 11, 12, 13, and 14, under contract, and on the 7th of September, 1850, the Canal Board, upon the recommendation of the State Engineer and Surveyor, resolved to construct sections Nos. 6, 7, 8, 9, and 10, (the remainder of the line between Tonawanda creek and Lockport,) on a plan of 90 feet width at top water line, and eight feet depth of water. The canal from Lockport west, through the rock cutting, for two and a half miles, is already enlarged, and the portion here referred to is that between the rock cutting and the guard lock.

On the 16th September, 1850, the Canal Board adopted the following resolution:

"*Resolved*, That the enlargement of the Erie canal through the villages of Brockport, Albion, and Medina, to the extent represented and described by the surveys, maps, plans, and specifications this day presented by the State Engineer and Surveyor, be and the same is ordered to be constructed of the dimensions required by the following description of the size of the canal, and upon the level described in the following resolution, to wit: At the lowest lock at Lockport, the mean width of the waterway of said canal shall be ninety-one feet, and the depth of the same nine feet; and from thence the water channel of said canal shall regularly diminish, (except where a saving of expense will warrant a wider channel,) to a mean width of sixty-two feet, and nine feet depth of water, at the point where the present enlarged canal in the city of Rochester is sixty-two feet in mean width; thence to the Rochester aqueduct to have a mean width of sixty-two feet, and a depth of nine feet water; and thence to the easterly end of said aqueduct, as the same now is; and thence to the first lock east of Rochester, said canal to have a mean width of waterway of sixty-two feet, and a depth of eight feet."

This resolution was passed in pursuance of section 3d, chapter 354, Laws of 1850, which requires the Canal Commissioners to enlarge the canal through the villages mentioned therein, and have the same completed by the first day of April, 1852, and directs the Canal Board to cause the State Engineer and Surveyor to make at once the necessary examinations and surveys to ascertain the proper level for the canal between Lockport and the first lock east of Rochester.

The plan of the Canal Commissioners and Engineers has ever been to supply the canal with water from Lake Erie as far eastward as the Montezuma level. (See their annual report of 1836, page 16; also of 1841, pp. 42, 43, and 44.)

The water of the Genesee river has been for several years turned into the Erie canal at Rochester, as a temporary feeder during seasons of drought; it is also used to feed the Genesee Valley canal. The mill owners at Rochester have ever protested against this, and have obtained from the Legislature an act recognizing their rights and empowering the Canal Board to make reservoirs of certain lakes, to throw the water therefrom

into the Genesee river, to compensate for the water taken to feed the Genesee Valley canal.

Examinations and surveys have been made pursuant to the provisions of the law, and the quantity of water permanently diverted from the Genesee river has been ascertained to be, at the time of making the surveys, 4,650 cubic feet per minute.

It has never been in contemplation to make a *permanent* feeder to the Erie canal from the Genesee river. The extraordinary amount of business upon the canal in 1836 and 1837 required its use, and it was the plan of the Commissioners at that time to enlarge the canal between Lockport and Rochester at once, so that water might be brought from Lake Erie instead of taking that of the Genesee, and thereby depriving the Rochester mills of a large part of their power, greatly to their injury. The suspension law put a stop to the kind intentions of the Commissioners, and the use of the water of the Genesee has been continued in dry seasons, up to the present time. (See Canal Com. Report for 1841, pages 42, 43.)

It is the opinion of this Board that justice should be done to Rochester. The Legislature has acknowledged their claim, and their rights ought to be secured to them.

In 1841 there were four chief engineers employed on the Erie canal enlargement. By a resolution of the Canal Commissioners, the 12th April, 1841, these engineers were required to report to them "the amount of declivity necessary to be given to the bottom of the canal from the foot of the new locks at Lockport, to the aqueduct at Rochester; and also the width of the canal and height of banks necessary between these two points to secure a supply of water at all times from Lake Erie to the Seneca river *without resorting to the Genesee river.*"

Before the engineers could get the necessary data for their report the public works were suspended.

After the resumption in 1847, the Canal Commissioners called on Mr. Childs, one of the former chief engineers, who was still employed on the enlargement, for this report. It was published with the annual report of the Commissioners in 1848. From it we learn that 25,448 cubic feet water per minute would be required to start at Lockport to supply the canal from there to Montezuma level. This was to supply the losses by filtration, leakages, evaporation, and lockages for 122 miles, without making any provision to return to the Genesee river the water wasted by

the Genesee Valley canal. We also learn from this report that a canal with a top-water surface of 81 2-10 ft.—10 8-10 ft. in depth at Lockport, and seventy feet top-water surface and eight feet deep at the first lock east of Rochester, will be required. And that this size is barely enough to supply the requisite quantity of water for navigation under the most favorable circumstances. No allowances are made for obstructions of any description, other than what a plain and straight channel will oppose. The surface declivity between the two extremes was to be 2.823 feet, and the bottom declivity 1.95 feet. This plan would raise the water 9.09 feet above the mitre sill at the lowest lock at Lockport.

Mr. Childs says, "admitting the loss from filtration through the bottom and sides of the canal and from leakages at the mechanical structures, to be as the square root of the pressure or depth of water, and as the area of the surface pressed; then the quantity required to supply the loss from these causes, upon the canal when enlarged, will be to the quantity required by the present canal, as 223.54 is to 100, &c."

He says the quantity used upon the present canal from the same causes, is 85 cubic feet per mile, per minute; it has been the practice to estimate it at 100 cubic feet per mile, per minute. He says, also, that 190 cubic feet per mile, per minute, will supply the losses by the same causes, for the enlarged canal between Lockport and the first lock east of Rochester.

Let us apply the above rule to the dimensions of the canal, as recommended by him, between those two places, and see if 190 cubic feet per mile, per minute, will be enough.

When Mr. C. says that "the quantity required to supply the loss from these causes upon the canal when enlarged, will be to the quantity required by the present canal, as 223.54 is to 100," he undoubtedly means an enlarged canal of 70 feet top water, 42 feet bottom, and seven feet in depth; for we find by applying the rule above quoted, the statements to be as follows: The old canal is four feet deep; 28 feet bottom, with slopes $1\frac{1}{2}$ to 1; so that the "surface pressed" is equal to 38.16 feet area for each lineal foot. The enlarged canal ordinarily is 7 feet deep, 42 feet bottom, slopes 2 to 1, and the "surface pressed" is equal to 64.18 feet per each lineal foot.

Now, if the old canal were 7 feet deep, the filtration would be as $\sqrt{4} : \sqrt{7} :: 85 : 112{,}41$ cubic feet per mile, per minute, instead of 85; so that the filtration of the enlarged canal of the ordinary

size, will be, say as 38 : 64 : : 112,41 : 189,32 ; very nearly 190 cubic feet per mile, per minute.

Now the dimensions of the canal recommended in this report of Mr. C. are, according to the tabe No. 2, 10.80 feet deep, 38 feet bottom, slopes 2 to 1, at Lockport, and at and near Rochester 8 feet deep, 38 feet bottom, slopos 2 to 1.

Now the $\sqrt{10.80}=3.28$.

and the $\sqrt{5.40}=2.32$.

The length of the slopes at Lockport=48.30.

3.28 : 48.30 : : 2.32 : 34.17, the width of bottom that would discharge a quantity equal to that discharged from the slopes ; so that the "surface pressed" at Lockport is $38+34.17=72.12$. Now $\sqrt{4}$: $\sqrt{10.80}$: : 85 : 139.40, the quantity the old canal would waste if it were 10.80 feet deep, and we shall get the quantity which the first mile at Lockport will waste by the following proportion, 38 : 72 : : 139.40 : 264.13 cubic feet per mile per minute, at Lockport; and at Rochester it wil lbe $\sqrt{4}$: $\sqrt{8.}$: : 85 : 120.27 and the surface pressed will be equal to 63.36, so that 38 : 63.36 : : 120.27 : 200.53 cubic feet per mile per minute at Rochester.

Now $\frac{200.53+264.13}{2}\times 63.55$ miles between the two places equals 14764.57 cubic feet per minute required for the whole distance or 232.33 cubic feet per mile per minute, instead of 190. Mr. C. estimates 13290 cubic feet per minute as the quantity necessary to pass Rochester $14764.57+13290=28054.57$ cubic feet per minute required according to his rule, to start from Lockport to supply the "leakage, filtration and evaporation" on the whole 122 (126) miles, instead of 23181.10 as he gives the figures.

He has calculated the distance only to Pit lock; that is now to be abandoned and the level raised to the elevation of that above the lock, and four miles must be added to the distance, making it 126 miles instead of 122. This increases the quantity $208.59\times 4=834.36$.

Then he is rather too particular in providing for lockages. It is believed to be the best policy where the source of supply is ample, to provide means sufficient to pass water enough to supply all the lockages that will become necessary to pass boats in both directions without regard to the probabilities in favor of saving water by the meeting of boats at the locks passing in opposite directions.

When the source of supply is limited, it is good policy to show to the public, and to capitalists especially that one lock full of

water will pass one boat each way, and by the doctrine of chances to show the probable proportion of single lock fulls that will be used to pass two boats. This gives confidence in the ability of the work to perform a given amount of business.

According to the terms of the proposition in this report of Mr. Childs, to wit: that the "loss by leakage, filtration, &c.," is as the square root of the pressure, and as the area of the surface, which is believed to be true, instead of increasing the quantity by 190 cubic feet per mile per minute between Rochester and Lockport, he should have increased it by 232.27 cubic feet per mile per minute making a deficit in his calculations of 2,686 cubic feet per minute to be passed at Lockport. Add to this the loss by the same causes on four additional miles of canal, 835 cubic feet per minute, and his deficient calculations for lockage water, 1,733 cubic feet per minute, and for leakage at last lock and waste by the flowing of boats from the locks, 1,200 cubic feet per minute, and we have 31,904 cubic feet per minute as the quantity which Mr. C. should have based his calculations upon as necessary to pass the Lockport lock for the use of the canal. To this amount must be added the quantity necessary to compensate the Rochester water power, 4,105 cubic feet per minute, making a total of 36,009 cubic feet to be passed at Lockport, and for which a channel is to be provided thence to Rochester, allowing an average loss on each mile of 232 cubic feet per minute.

In 1849 Henry Tracy, C. E., was employed to examine and report upon the same subject.

Mr. Tracy's report was published in 1850. From this we learn that 29,600 cubic feet of water per minute would be required to start from Lockport for the purpose of supplying the loss by filtration, evaporation, leakage and lockages, making no provision for the Rochester millers.

The plan recommended by Mr. Tracy is a canal with 85 feet width of surface at Lockport, 13.2 feet depth of water, and 70 feet surface at the first lock east of Rochester, and seven feet depth. Surface declivity 6.2 feet; the bottom to be level. His plan raises the water 9.54 feet above the mitre sill of the lowest lock at Lockport.

Both of the plans, it will be noticed, contemplate raising the water to an extraordinary elevation above the mitre sill at Lockport.

The citizens of the villages along this line apprehended great inconvenience to their roads and dwellings in consequence of this extreme height of water, and supposing there was no possible means of avoiding it, other than cutting down the bottom of the Rochester aqueduct, they set about devising a way to ascertain whether this could be done, and procured the passage of the section of the appropriation law of 1850 above quoted.

The Canal Board, acting under this law, directed the State Engineer and Surveyor to examine the subject and report as soon as possible.

On the 12th September, 1850, he reported the following as the proper level for the canal between the two points designated in the law, to wit:

"Beginning at a point seven feet six inches above the mitre sill at the lowest lock in Lockport, and flowing on a regular inclined plane to a point seven feet four inches above the bottom of the Rochester aqueduct, at the distance of one hundred feet west thereof: thence on a regular inclination to the first lock east of Rochester to a point seven feet above the level of the bottom of said aqueduct."

The Board adopted this as the top water level of the canal. The size and form of the prism of the canal is not yet fixed for the whole distance; but the dimensions given in the above resolution are those recommended by the State Engineer and Surveyor for the whole distance between the extreme points named in the resolution, in case a supply of water for the canal from Macedon to Montezuma cannot, for a reasonable expenditure, be had from the Canandaigua lake.

Should the examinations prove this to be practicable, and it should be deemed good policy to construct a feeder from that lake to the Macedon level, the dimensions of the canal between Rochester and Lockport may be reduced to the ordinary size, with an additional sectional area sufficient to supply to the Rochester millers the water wasted by the Genesee Valley canal. The Board deems this a necessary element in determining the proper dimensions for the canal between these two places, because it is believed to be less expensive and objectionable than a resort to the lakes before mentioned.

The necessity of putting the work under contract through the villages of Brockport, Albion and Medina, at an early day, to enable the Canal Commissioners to comply with the statute, com-

pelled the Board to adopt the largest dimensions suggested for the prism of the canal at those places.

There will be no disadvantage in this, should the remainder of that level, after further investigation, be reduced to less size in the prism.

The engineers estimate the quantity of water as necessary to start from Lockport, as follows:

	Cubic feet.
Leakage, waste, and evaporation, on 126.30 miles	27,794
Lockages for 11 lockages per hour	4,000
Compensation to Rochester water power	4,105
	35,899

The velocity between Lockport and Rochester, 44.4 feet per minute, or about half a mile per hour.

The above are all the variations from the width of 70 feet, made by the Canal Board between Buffalo and Syracuse.

The canal is constructed wider than 70 feet at various points along the whole line, whenever a reduction of cost can be made thereby.

Herewith are all the resolutions of this Board called for by the Senate, numbered 1 to 5 inclusive.

(No. 1.)

STATE OF NEW YORK:
CANAL DEPARTMENT,
ALBANY, *January* 21, 1851.

At a meeting of the Canal Board:

Resolved, That the Canal Commissioners be directed to lengthen the locks between Syracuse and Rochester, so as to admit the largest class of boats now plying upon the Erie canal, in pursuance of the law of 1849, chapter 233.

(No. 2.)

STATE OF NEW YORK:
CANAL DEPARTMENT,
ALBANY, *Feb.* 10, 1851.

At a meeting of the Canal Board:

Resolved, That the resolution of this Board, of the 21st January last, directing the lengthening of the locks between Syracuse and Rochester, be, and the same is hereby rescinded.

(No. 3.)

STATE OF NEW YORK:
CANAL DEPARTMENT,
ALBANY, *Feb.* 18, 1851.

At a meeting of the Canal Board:

Resolved, That the Canal Commissioners be authorized to lengthen and widen the old locks between Syracuse and Rochester, by the opening of navigation, if in the judgment of the Canal Commissioners and State Engineer and Surveyor, it can be done consistently with the interests of the State; and if the Commissioners and Engineer shall determine that the locks cannot be enlarged with safety, by the opening of navigation next spring, then the Commissioners are directed to enlarge the same by the opening of navigation in the spring of 1852.

(No. 4.)

STATE OF NEW YORK
CANAL DEPARTMENT,
ALBANY, *Sept.* 7, 1850.

At a meeting of the Canal Board:

The State Engineer and Surveyor having presented to the Board the maps, plans, estimates and specifications of sections No. 6 to No. 10, inclusive, of the Erie canal enlargement west of Lockport, at an estimated cost of $382,033.41 on a plan of 8 feet depth of water, and 90 feet width of surface, to be completed by the first day of April, 1853: Also of sections No. 79 to 106 inclusive, excepting sections No. 91 and No. 98, on the Genesee Valley canal, extending from the Genesee river feeder to Olean; also 19 road bridges and 19 farm bridges; also 33 locks, and necessary culverts, and other structures on the same sections, at an estimated cost of $394,204.07, to be completed by the first day of April, 1853; also of sluices for 70 locks on the Black River canal, to be completed before the opening of navigation in the spring of 1851, at an estimated cost of $15,771:

Resolved, That the said maps, plans, estimates and specifications be, and the same are hereby adopted.

(No. 5.)

STATE OF NEW YORK:
CANAL DEPARTMENT,
ALBANY, *Sept.* 16, 1850.

At a meeting of the Canal Board:

Resolved, That the enlargement of the Erie canal through the villages of Brockport, Albion and Medina, to the extent repre-

sented and described by the surveys, maps, plans and specifications this day presented by the State Engineer and Surveyor, be, and the same is ordered to be constructed of the dimensions required by the following description of the size of the canal, and upon the level described in the following resolution, to wit: At the lowest lock at Lockport the mean width of the water way of said canal shall be ninety-one feet, and the depth of the same nine feet; and from thence the water channel of said canal shall regularly diminish, (except when a saving of expense will warrant a wider channel,) to a mean width of sixty-two feet, and nine feet depth of water, at the point where the present enlarged canal in the city of Rochester is sixty-two feet in mean width; thence to the Rochester aqueduct, to have a mean width of sixty-two feet, and a depth of nine feet water; and thence to the easterly end of said aqueduct as the same now is; and thence to the first lock east of Rochester; said canal to have a mean width of water way of sixty feet, and a depth of eight feet.

CHRISTOPHER MORGAN,
Secretary of State.
PH. C. FULLER,
Comptroller.
A. HUNT, *Treasurer.*
H. C. SEYMOUR,
State Engineer and Surveyor.
CHARLES COOK,
FREDERICK FOLLETT,
Canal Commissioners.

The dimensions adopted by the Canal Board in September, 1854, for the canal on the long level extending from Lockport to the first lock east of Rochester, were as follows: 91 mean width, and 9 feet depth at Lockport; 62 ft. mean width, and $7\frac{1}{4}$ ft. depth at Rochester. The bottom line at Lockport to be $1\frac{1}{4}$ feet below the top of the mitre sill of the lower lock at that place, and descend thence on a regular inclination to a point two inches below the bottom of the aqueduct at Rochester.

On all completed sections the water, during the past season, has stood 6 feet deep and over, while the surface, when the work is fully completed, is to be raised at Lockport $1\frac{3}{4}$ feet, and at Rochester about one foot above its present height, which will

afford 7 feet depth on all parts of the level, and more than that for the greater portion of the distance between these places.

For the purpose of obtaining a supply of water, mainly from Lake Erie, for this division of the canal, it was designed that the section of prism west of Rochester should be larger than that adopted on other portions of the line. Between Black Rock and Tonawanda the surface width is to be 80 feet, and bottom width 60 feet. From the village of Tonawanda to Pendleton the Tonawanda creek is used, and the bars which occur therein are to be dredged to the depth contemplated for the enlarged canal. From Pendleton to Sulphur Spring guard lock, surface width 100 feet; from guard lock to head of rock cut, 90 feet, and from this to head of combined locks at Lockport, 62 feet, with vertical sides. The water, during the past season, has stood 9 feet above the bottom line established for the several portions of canal above named.

Total number of boats of all classes on the canals, 5,568.

Cost to complete the Canals.

After the passage of the loan for $11,558,955, (10 per cent. added,) new surveys and estimates for letting were ordered by the Canal Board on the 28th July. These were completed Oct. 10th, 1851. Proposals were received until Nov. 18, and the opening of bids commenced on the 20th, and closed the 24th. Over 2,600 bids were received, which occupied the Engineers 12 days in canvassing. The following is the statement of estimated cost to complete the following canals at Engineer's and contract prices:

CANALS.	Length in miles.	Estimated cost.	
		Engineer's prices.	Contract prices.
Enlargement of the Erie canal	222¾	$8,774,685 22	$7,538,091 45
Black River canal	48 44-100	237,540 00	222,076 60
Genesee Valley canal	30	200,000 00	193,570 00
Totals		$9,212,225 22	$7,953,738 05

Total amount of work under contract.......... $11,271,559 83
to complete 9,552,450 33

Enlargement Fund.

Amounts received, &c., from 1834 to Sept. 30, 1851: from tolls, to pay interest, $5,581,637.10; to pay for construction, $6,736,-

877.36; loans issued to pay for construction, $10,221,341.31; total, $22,539,855.

Drainage of Cayuga Marshes.

To the Honorable the Legislature of the State of New York:

The undersigned commissioners, appointed in pursuance of an act entitled "An act in relation to draining the Cayuga marshes," passed July 10th, 1851, report:

That soon after their appointment they held a meeting of the commissioners at Syracuse, and prepared directions to the State Engineer and Surveyor for such surveys and levels as they deemed necessary to an understanding of the subject upon which the law required them to report.

The unhealthiness of the district to be examined, and some other causes unforeseen at the commencement, prevented the completion of the labors of the Engineer as soon as was desired.

It appears that the report of the Hon. George Geddes, engineer in charge of the surveys and levels, was filed in the office of the late State Engineer and Surveyor on the 31st day of December last, and upon our application a copy was communicated to us by the present State Engineer and Surveyor on the 8th of January last, which we submit herewith, with the maps and profile accompanying the same.

We earnestly recommend this report of Mr. Geddes to the attention of the Legislature. It presents in a clear and practical manner the causes which have combined to create the vast marshes bordering on the Seneca river, and suggests the means by which they may be permanently reclaimed.

As soon as the work under charge of the principal engineer had so far progressed as to prepare him to afford us useful information, we accompanied him in an exploration, by water, of the Seneca river and Cayuga marshes, in which we made the only examination that can be made, except at times when the river and marshes are so frozen over as to allow of traveling upon them on the ice.

This personal inspection has been useful to us by aiding us to understand the scientific report of the engineer, and to appreciate the great importance of the improvement contemplated.

The commissioners met at the commencement of the present session of the Legislature, to prepare their report, intending to present the same within the time contemplated by the act of July 10th, 1851, but they were unable to find any records of the

proceedings of the commissioners appointed under the act of 1825, and they deemed a knowledge of these of sufficient importance to delay the report until further searches could be made. Those searches have been prosecuted, and have within a few days been partially successful.

The delay of this highly important and necessary work for so long a time after the settlement of western New York, its suspension after a commencement, and its neglect until the last session of the Legislature, must be ascribed to the engrossment of the energies and resources of the State for the greater portion of the time, when the financial condition of the country would allow, in the prosecution of other great works of improvement.

The fact that the lands to be benefited belonged to a great number of individuals, and that the State had little or no direct interest in them by ownership, has probably been another cause of the neglect of the subject.

In the year 1825, under an act of the Legislature of that year, a survey, map, and assessment of all the lands embraced in the Cayuga marshes and swamps on the Seneca river were ordered to be made. This was accomplished, but the map cannot be found in the Comptroller's office, where it was required to be filed; but the field notes of the surveys, and the assessment roll, a copy of which accompanies this report, made by the commissioners appointed for that purpose, shows an aggregate quantity of near thirty thousand acres of land, appraised at an average price of less than eighty-four cents per acre.

We are informed that this survey does not include large bodies of land which will be greatly benefited by the reduction of the water of the river. We have no means of testing the accuracy of this information, but are induced to believe it is true, to an extent worthy of consideration, in providing for a future equitable assessment to defray the expenses of the improvement.

This immense body of land is in the heart of the most fertile, beautiful and prosperous part of the State, and is capable of being made itself of the most productive and valuable quality, instead of being, as it now is, not only utterly unprofitable and totally useless to its owners, but an unsightly blemish upon the fairest portion of our State, a colossal nuisance, and a source of continued and wide-spreading pestilence to the surrounding country.

The attempt to redeem these lands, made under the law of

1825, proved a failure. Instead of lowering the bed of the river on Jack's reefs, an attempt was made to reduce the streams by a cut across a short but elevated neck of land, requiring an immense expenditure in excavation above the natural surface of the river. Had the money expended upon this cross cut, in making a miniature canal through deep rock excavation, been expended in removing the reef itself, and the bar at Musquito point, the Cayuga marshes and swamps would long since have been what it is believed they are destined to be, and proprietors would have realized wealth from their ownership, after reimbursing the State for its expenditures in their improvement.

The elevated and rocky bottom at Jack's reefs, and the gravelly bar at Musquito point, are the principal barriers that hold up the waters of the Seneca river and spread them over these lands. Not only the best, but the only feasible plan of draining and reclaiming these lands is to remove these barriers — first, that at Jack's reefs, and next, that at Musquito point — to such an extent as to transfer the falls or rapids at those points successively to the next shoal water above them. These are not only the first, most material and important, but perfectly indispensable operations, and any work done previous to the removal of these two obstructions would be useless.

The estimated cost of the necessary excavations at these two points, Jack's reefs and Musquito point, according to the report of the engineer, is ninety-two thousand dollars. This once accomplished, it is believed that the remaining obstructions, being for the most part of very soft materials, under the force of the current created upon them by the removal of the two first, aided by the ordinary freshets of the stream, would soon be washed into the deep pools which are found below all these bars. At all events it would require but little assistance from a dredging machine to stir up the soft bottom, in aid of the current, to remove them effectually.

The estimated cost, according to the report of the engineer, of the whole work necessary to reclaim these marshes, is within the sum of one hundred and fifty thousand dollars, which the undersigned believe is a greater sum than will be necessary to accomplish it.

The question arises, from what sources and in what manner shall the necessary funds be obtained?

By the act of 1825 it was provided that an assessment roll, to

which we have heretofore referred, of all the lands to be affected by the improvement, should be made out at their then value. The money for the work to be advanced by the State, and after its completion it was provided that a new assessment of the lands should be made at their improved value, and a tax levied upon them sufficient to reimburse the State the money advanced.

The same course may be adopted now. The average price of lands bordering upon these marshes is not less than thirty to forty dollars per acre. The marshes when reclaimed will be far more valuable than the adjacent lands, and amply sufficient to pay the necessary advance of the State, and leave a large profit to the owners, resulting from the operation.

In view of the facts herein presented, the undersigned respectfully recommend the passage of a law ordering the draining of the marshes on the Cayuga lake and Seneca river, providing for the reimbursement of the money to be expended thereon, by assessment on the lands benefited by the improvement.

All of which is respectfully submitted.

ALBANY, *February* 12*th*, 1852.

W. H. ADAMS,
H'Y FITZHUGH,
J. B. WILLIAMS.

Report of Civil Engineer.

Hon. HEZEKIAH C. SEYMOUR, *State Engineer and Surveyor:*

Sir—I have made a survey of the Seneca river from Cayuga lake to Baldwinsville, with a view of answering the interrogations proposed by the commissioners appointed by the Governor to report a plan for draining the Cayuga marshes, and also with a view to the lowering of Cayuga lake.

I commenced my examinations on the 14th day of August last. Benches were established at various places on the shore of the river, early in September, with a view to observe the rise and fall of the water, and a party under the immediate direction of Levi Williams, civil engineer, commenced leveling on the first day of October; since which time we have been busily engaged in field and office work. The weather has been unfavorable, and it has been, therefore, necessary to make great exertions to accomplish what we have. Further surveys are necessary to determine the quantity of marsh and swamp injured by the water of the river. I cannot learn that this has ever been accurately

done, but I have the quantity stated at from thirty thousand to fifty thousand acres.

In making my report I have, for convenience, followed the order of the interrogatories put by the commissioners.

1st. The highest water of Cayuga lake, for the last twenty years, was three feet and sixty hundredths above the lowest water of this year, the water being lower this year than it has been for many years previous. In 1831, the late James Geddes, civil engineer, made some examinations of the outlet of Cayuga lake, by order of the Canal Commissioners. From his report I made the following extract:

"When the deep and narrow cut was made across the bend of the Seneca river, below Cross lake, it was supposed that the operation would be to drain the water from the Cayuga marshes very low by midsummer, but that it would not be taken off sufficiently *early* in the season. Results have been quite otherwise. The spring floods recede until June or July, when the water commences rising and continues on the rise until the first of October, later or earlier, according to the setting in of the fall frosts, which cut down the luxurious growth of herbage that had risen in the bed of the river during the hot season and obstructed the passing off of the water.

* * * * * * * * * *

"The water in the outlet, and consequently in Cayuga lake, was higher in September and October than in April, raised and held up by the herbage growing in the bed of the river. The vegetables springing up here in warm weather are named by the fishermen *eel grass*, and classed by the botanists among the very numerous varieties of CONFERVA. This weed grows in shallow places on muddy bottoms."

The outlet of the Seneca and of the Crooked lakes discharges into the lower end of Cayuga lake, and sometimes freshets from these lakes are in the summer season discharged into the Cayuga, which being held up by the grass that obstructs its outlet, causes very great rises in the water. This eel grass fills the river in shallow places through the whole extent of the marshes, and causes the water to remain on them long after it would otherwise have passed off.

The outlet of Cayuga lake is shallow and narrow at the place where the lake ends and the river begins, having but 1,815 feet of water way; and as late as the 29th day of November last,

more than a sixth part of this shallow channel was choked with weeds.

2d. The fall of the surface of the water, from a point above the Rochester and Syracuse railroad, as ascertained by levels that were taken in the month of October, 1851, to the top of the dam, as determined by the monument erected by authority of the State, at Baldwinsville, was 12.64 feet, and was distant from the place of beginning, measuring on the river surface, a little more than thirty-eight miles; measuring by the line of our levels, it was 222,450 feet, a little more than forty-two miles, and the fall was distributed as follows:

	Feet fall.	Feet.
From Cayuga lake to Seneca canal, distance	9.600	0.170
upper end of Free Bridge reef.	16.200	0.341
lower do do do ..	17.800	1.200
Montezuma do do ..	36.000	2.593
Bluff point	57.600	3.665
Hard point	64.200	3.993
Campbell's island reef	67.500	4.157
foot of do	70.200	4.338
head of reef at Howland bridge	74.100	4.338
foot do do do	75.700	4.416
head of Musquito point reef..	82.200	4.494
foot do do ..	86.400	4.989
Weedsport bridge, distance..	111.000	5.448
Skaneateles creek, distance..	126.000	5.747
west side of Cross lake......	139.800	5.843
head of Jack's reefs canal ...	159.600	5.890
foot of Drake's mill race.....	167.400	5.989
Jack's reefs bridge	170.100	6.816
foot of reef................	178.200	11.139
level of Baldwinsville pond..	180.600	11.489
water at top of dam........	222.450	11.967
top of dam as fixed by monument		12.642

The results differ at some points from what had been reported as the fall by persons who had previously made examination of this river; but there is nothing that cannot be accounted for and reconciled when the laws that regulate this stream are understood. The fall at the various points mentioned will vary with every change in the quantity of water running in the river, and as the weeds obstruct the flow of the water, our levels com-

menced on the first day of October, the weeds having dammed up the water in the lake and in the marshes; the river was low because the supply was cut off. When the weeds were killed by the frosts the lake fell, so that, on the sixth day of November, it was one foot and nine hundredths of a foot lower than when we commenced.

In the spring freshets the water rises at Musquito point as high as 5.14 feet above the water, when we took its height. If Cayuga lake should be at the same time at its highest mark, then there would be but two feet and twenty-three hundredths fall from the lake to Mosquito point.

3d. The channel of the Seneca river varies in width from 300 to 3,100 feet. Its width at the point where the Cayuga lake ends was, on the 29th day of November, 580 feet, and of an average depth at that place of 3.13 feet; at the place where the Jack's reef bridge crosses the river it is but three hundred feet wide, the shores being from eight to twelve feet higher than the surface of the water, consisting of slate and gravel; at Weedsport bridge the river is but 300 feet wide, the shores being low; at Musquito point the river was, on the 11th day of November, but 400 feet wide and of an average depth of three feet, the shores being from four to twelve feet above the water and the bottom and sides made of hard gravel.

Musquito point was but recently the lower end of Cayuga lake, and now as often as the water is very high it becomes so. At this place the hard land approaches the river on both sides, and the evidences that the river has worn its way down into the gravel some feet, are too strong to be resisted.

There are no places in the river so narrow as to make it necessary to widen the channel for the purpose of draining the marshes.

4th. As to the depth of the channel :—Soundings have been taken in the river with great care, at known distances apart, from the east end of the waterway through the Rochester and Syracuse railroad embankment, across the lower end of the lake to the deep water below Jack's reef, so as to give the requisite data to calculate the amount and character of the earth that it might be necessary to move to drain the marshes.

Below Jack's reef the soundings have been taken opposite stakes on the shores, but not from a line stretched on the water. The profile that is submitted with this report, will exhibit the

top and bottom of the water as it was in October, and it is not necessary here to give the soundings.

The first shallow place is at the point where the lake ends, which is distant, in a direct line from the place of beginning, one mile and a half and five hundred feet. The water was here but four feet deep in the deepest place, the surface falling a third of a foot. The bottom is made of sand and mud, and, as has been remarked, the channel is much choked by weeds. This shoal is about fifteen hundred feet long. The next shallow is two miles from the place of beginning, and the water was but 3.60 feet deep. The bottom is mud and the shoal is but about 800 feet long. The fall in the surface of the water at this place is too little to be noticed.

The third shoal is known as the Free bridge reef, being three miles from the place of beginning, and is about 3,000 feet long. The fall of the surface of the water here is about 86-100 of a foot. The bottom is hard, consisting of coarse gravel. The water averages about four feet deep in the channel. At the lower end of this shoal there is an island, and the west channel, though only about 100 feet wide, is generally 8 to 9 feet deep, except where it joins the east and main channel, where the depth is only four feet.

At the head of Kipp's island, which is nearly five miles from the place of beginning, there is a bar on which the water was only three and a half feet deep. This shoal is about 1,700 feet long, and is made of sand and mud. Kipp's island is three and a half miles long, and is crossed by the Erie canal at Montezuma, which is about six and three-fourth miles from the place of beginning. The west branch of the river is deep, averaging about sixteen feet through; in one place it is for about 100 feet in length, only seven feet deep. This bar is below the canal, and is said to have been formed by the sinking of a raft at that place many years ago.

A little below the upper end of Kipp's island, a stream that is marked on the large maps of the State as "Clyde river" joins the Seneca. This river is formed by the outlet of Canandaigua lake and Mud creek, and is a very considerable stream, much more affected by freshets than in the Seneca river above its mouth. This river very often raises so high than when it meets the west branch of the Seneca, it divides its waters, and sending part of them south fills up Cayuga lake as well as the marshes.

The west channel of the Seneca at Kipp's island, is generally called by the inhabitants the Canandaigua river.

In constructing the enlarged Erie canal, it has been decided to fill up this west branch where the canal crosses it, and cut a canal across the island to the east branch, for the discharge of Clyde river into it; the canal to cross the marshes high enough to pass the river under it. By this plan the whole water must go down the east channel from a point above the canal, unless it is sent again across the island, which can be easily done by widening and deepening the old canal.

Nine miles from the place of beginning, commences Bluff point shoal, which, including Campbell's island shoal, is about three miles and a half long, the water in many places being not more than three feet in depth; above Bluff point the river and bay are 3,100 feet wide, across which the direct railroad from Rochester to Syracuse is now in the course of construction. The bottom here is soft mud, very easily moved by the dredging machine that has been used for excavating the foundation for the railroad bridge. The fall in this shoal (including what is called Campbell's island reef,) is one foot and nine inches. Most of this long shoal was thickly covered with eel grass, so that, but for the great width of the river, the flow of the water would have been nearly stopped.

About thirteen and five-eighths miles from the place of beginning, is Howland's island bridge, at which there is a shoal about 300 feet long, the shallowest water being only about five and a half feet in depth, but twenty feet deep above and below.

Fifteen miles from the place of beginning is Duval point. Just above which there is a shoal about a thousand feet long on which the water is 8.60 feet deep. At Duval point is a shoal about 300 feet long, on which the water is nine feet deep.

Musquito point is from the place of beginning fifteen and three-fourths miles, where the water was but three and a half feet in depth; as above stated, here is but what was recently the lower end of the lake. The channel is not only shallow, but narrow, being only 400 feet in width; nothing can be effectually done towards reclaiming the marshes without cutting away this barrier, so as to give a free outlet to the water. The length of this reef is 2,000 feet, with deep water above and below; the fall in the surface was 49-100 of a foot. About one mile lower down stream is a bar, on which there is a bridge; the length of the bar is about 300 feet, and the depth of the water seven and a half feet.

About nineteen miles from the place of beginning is Hickory island reef, where the water, in one place, was only three feet in depth, the bar being about 800 long and of soft mud. The fall at this reef is 46-100 of a foot.

At Weedsport bridge there is a short bar on which the water was five and a half feet deep; the mud is very soft, as was shown by the action of a dredging machine at work there this season. The fall is about one and a half inches.

About a mile above Bonta bridge and twenty-two and three-fourths miles from the place of beginning is a small bar on which water was seven feet deep.

Bonta bridge reef has six feet water in its shallowest place, and is about 500 feet long. There is about 30-100 of a foot fall at this place; the bottom soft.

Just below the mouth of the Skaneateles creek there is a short bar on which the water was seven feet deep. This was the last bar found above Jack's reefs, where the water was less than ten feet in depth; in one place, near the float bridge, the water was forty-three feet deep.

The State, many years ago, caused a canal to be cut across a bend in the river, below Cross lake, connecting the pond made by the Baldwinsville dam with the waters of the river when they were on a level with Cross lake, and where the water was twenty feet deep, and not less than that in the shallowest place between that point and the lake. In the part of the river thus cut off is Jack's reefs. The water falls in this canal five and a quarter feet. This canal is 4,200 feet long, and is, at the surface of the water, of an average width of about forty feet, and is of an average depth of about twenty-three feet, and was cut through a soft rock, known as the *green shale.* The water varies in depth from 8.80 feet to 2½ feet; about midway of the length of the canal the bottom is two-tenths of a foot higher than the surface of the water in the pond below the reefs.

It is apparent that though the water runs very rapidly through the lower half of the length of this canal, that but a very small part of the water of this great river can go through it. It appears strange that the planners of this canal did not dig it deeper and make the bottom more level. For five hundred feet of the upper end the water is more than eight feet deep. In high water large quantities will of course go through but in low water very little.

The shale that was taken from the cut was deposited by cranes in large mounds on both its sides, and to widen it would require the removal of this earth on one side, that is to say, one-half the contents of the canal must be moved out of the way before the natural surface of the earth would be reached. This canal can be, and should be deepened, but the cost of *widening* it would be too great to justify its being done. It should be deepened so that the bottom would be six feet below the top of the water in the pond below the reefs, and rising only one foot in the whole length of the canal. Calculations have been made from careful measurement to determine the quantity of material that it would be necessary to move to so deepen this canal, leaving the bottom twenty feet wide, and it has been found to be 15,644 cubic yards, which I estimate to be worth sixty cents a yard, including the cost of dams across the ends of the canal and pumping; this would amount to $9,386. Such an improvement of the canal would, the river remaining at its present height, enable more water to pass than has at any time run in the river since the month of August last. Having thus deepened the artificial channel, a dam can be made across the bed of the river above the reefs and below the upper end of the canal, and thus the whole bed of the river may be freed from water except the small part of it that will require to be excavated below the level of the lower pond. To free this part of the river bed from water, a dam must be made across it just above the lower end of the canal and the water pumped out. I propose, then, to make a cut in the bed of the river one hundred feet wide on the bottom, and beginning six feet below the surface of the lower pond, carrying it up to the deep water above the reefs with one foot rise; the dams being then taken away, the water will run through both these cuts upon the bottom that will be at their ends on like levels. The reduction that would then take place in the surface of the water above the reefs would of course depend upon the quantity of water that may run in the river any given time.

Until after the frosts had in part destroyed the weeds in the river, it was not practicable to gauge the stream with accuracy. On the 12th day of November, it was found at Musquito point there were 1,397 cubic feet running per second. The water was then lower than it had been for many years; and calculations were made of the quantity that flowed in the middle of August, as indicated by the marks then made for the surface, and it was

found to be 1,947 feet without deducting anything for the weeds that at that time somewhat obstructed the flow of water. My calculations are based upon carrying 2,000 feet per second, four feet below the surface, as it was on the first of October last. The earth taken from the bed of the river, should be carried beyond the present channel, so as to be out of the way of the freshets that might raise the water up to the present bottom. To make this cut in the bed of the river, it will be necessary to move 54,743 cubic yards of mud and gravel. This I estimate to be worth fifteen cents a yard; under this earth lies the green shale, of which there must be taken out 165,106 cubic yards, which I estimate at 30 cents per yard.

The cost of coffer dams and pumping may be put at $5,000, and the total cost of lowering Jack's reefs, as I propose, will be $72,129. An estimate has been made for widening the present ditch so as to carry the same amount of water as I have above proposed, and it is found that it will be necessary to remove 381,888 cubic yards, in which view of the depth of cutting should be put at forty cents, and would cost $152,755. In one case it is necessary to remove earth to the average depth of 18 feet above top water mark; while in the other the excavation would be commenced three feet *below* the surface of the water; and the quarter length of the cut in the river (10,800 feet) would not equal in cost one-half of the shorter but deep cut.

This plan, except in freshets, would reduce the surface of the Cross lake four feet; and no more excavation would be required below the bar at the Skaneateles, to cut a channel at Skaneateles bar 200 feet wide, and so deep that there will be four feet of water in it after the river is reduced four feet; or in other words, eight feet deep, as the water was when measured, would require 740 cubic yards, which, at ten cents, would amount to seventy-four dollars.

At Bonta's bridge a like cut would be required, 2,222 yards, at ten cents, would amount to	$222 00
At the bar above the bridge a like cut would be required, 3,700 yards, which, at the same price, would amount to	370 00
The bar at Weedsport bridge, for a like cut, would require 2,220, at ten cents, would amount to	222 00
At Hickory island a like cut would require 38,516 yards, at ten cents, would amount to	3,851 00

These shoals are of such material that it is quite probable that,

by the aid of the current that would be given by having four feet additional fall, a large proportion would go away with the water if merely loosened up by a dredging machine. The mud taken up at Weedsport bridge this fall, by the dredging machine, was so soft and saturated with water that it appeared hardly possible for it to remain under the action of such a current as would be felt there when the water below the bar was reduced four feet. Nothing would be required to be done at the bridge about a mile below Musquito point.

The bar at Musquito point is, as has been said, hard gravel; but it is believed that it can be moved by an underwater excavator, some work having been done there by such a machine many years ago. I propose to cut this bar down six and a half feet at its highest point, and thereby make a bottom ten feet below the surface of the water, as it was when measured in October. This cut to be 200 feet wide and 2,000 feet long on the bottom, requiring 66,889 yards to be taken out, which I estimate at thirty cents per yard, amounting to the sum of $20,066.

Thus, I estimate the total cost of reducing the water four feet at Musquito point at $96,933.

The reason why I propose to cut so deep at Musquito point is, that the natural bed of the river is so narrow that the high water is here retained more than at any other point on the river; and unless free vent is given to it, reclaiming the marshes will be out of the question.

If the plan I propose should be adopted, the freshets that now cover the marshes would pass off rapidly, and would never rise so high, by two or three feet, as heretofore.

At Howland's island bridge it would be necessary to excavate 3,500 yards, which, being more compact than the mud bar, I put at twelve cents a yard, which amounts to $420.

Campbell's island and Bluff point shoals are together about three and a half miles long. The proper way of moving this mud is to reduce the water below as proposed, and, by the aid of a steam dredging machine, let the water carry it into the deep holes that abound in the river. It is very difficult to say what it will cost to move this mud by the yard, having the assistance of the current; but without its aid, it would probably cost fifteen cents, as indicated by the work done in excavating for the railroad bridge. But experienced men with whom I have advised on this point think, as I do, that adding the four feet fall

to the one and three-quarters now in the shoal, that little more will be required than to keep a dredging machine working out the channel to float away the soft mud; but to be on the safe side, I will call it ten cents.*

A cut of 210 feet, average width, would require 408,527 cubic yards, which, at ten cents, would cost $40,852, which makes $138,206, to the lower end of Kipp's island; and in this calculation, for the purpose of securing sufficient velocity of the water to prevent the cut filling up with mud, I propose to loose one foot-fall above the Musquito point, and reduce the water at Kipp's island only three feet.

If no account is made for increased expense in deepening the channel in consequence of the enlargement of the Erie canal, no work will be required on the west side of Kipp's island, unless it may be found necessary at the short bar heretofore mentioned as having been caused by the sinking of a raft; but it is not probable that anything more would be required at that place than to allow the increased current to act.

The Canandaigua would in this way be lowered three feet, and all the wet lands on its borders would be made dry for many miles.

At the upper end of Kipp's island there is a bar that should be cut down three feet, and two hundred feet wide. This would require the moving of 64,814 yards, which, at ten cents, would amount to $6,481.

Next above is the Free bridge reef, which, as has been said, is made of gravel. If this reef and two slight bars above were cut down, and also as has been proposed, at all points below, it would have the effect of lowering Cayuga lake from two to three feet. If the hard material of Free bridge reef were to be taken away, it is probable that the two bars above would be carried away by the water. It is my opinion that nothing should be done at this place until after the deepening below had been done, and its effect upon Cayuga lake determined.

* "It appears from observation, that a velocity of three inches per second at the bottom, will just begin to work upon fine clay fit for pottery, and however firm and compact it may be, it will tear it up. Yet no beds are more stable than clay when the velocities do not exceed this, for the water soon takes away the impalpable particles of the superficial clay, leaving the particles of sand sticking by their lower half in the rest of the clay, which they now protect, making a very permanent bottom, if the stream does not bring down gravel or coarse sand, which will rub off this very thin crust, and allow another layer to be worn off. A velocity of six inches per second will lift fine sand; eight inches will lift sand as coarse as linseed; twelve inches will sweep along fine gravel; twenty-four inches will roll along round pebbles an inch in diameter; and it requires three feet per second at the bottom to sweep along shivered angular stones of the size of an egg."—*Ree's Cyclopedia; article, Water.*

It is probable that without moving anything from the bed of the river at Free bridge, the lake would fall one foot. The freshets that have heretofore affected it would run off down the river, and the surface of the lake would be of a much more uniform height.

I have stated my plan in detail, and the whole cost I estimate at $144,687. If this plan should be adopted, the great object of making these pestilential marshes productive and healthy would be accomplished. Any plan that proposes less than this, appears to me to be useless.

5. I have been requested by the Commissioners, through you, to state, as far as practicable to do so, by the best means in my power, without waiting for the rise of the waters, the difference in the number of cubic feet of water passing the Seneca river at Musquito point and at Baldwinsville, in high and low water, and the amount of water commonly running to waste during the autumn months, the winter months, and the spring months.

I have already stated that in November there were 1,397 cubic feet passing Musquito point per second, and that my calculations suppose 2,000 cubic feet per second at the usual summer flow at Jack's reef, after the freshets of spring have subsided. From the high-water marks at Musquito point and Jack's reefs, calculations were made which gave 9,156 cubic feet per second as the greatest quantity of water that passed the place first mentioned in freshets.

Calculations were made, based upon the number of square miles that were drained by this river, and from the rain gauges kept at the academies on and near this territory, of the quantity of water that falls on it in a year, and having made such allowance as appeared proper for the evaporation, the average flow per second for the whole year at Jack's reefs is 2,651 cubic feet per second.

None of this water can be said to run to waste, except the spring freshets. The character of the country drained by this river is such that there can be no very high or very low water, and the flow is more uniform than in any river, with the exception of the St. Lawrence, with which I am acquainted. Over ten per cent. of the surface drained is made up of the Crooked, Seneca, Canandaigua, Cayuga, Owasco, Skaneateles and Cross lakes, and of water surface in the marshes, all acting as reservoirs and regulators of the flowing of the river.

The water in these lakes is very pure, and their shores are generally high and healthy, and the marshes are surrounded by the most fertile agricultural country in the State; but in these marshes the water is contaminated, and becomes so saturated with pestilence as to have conferred a very unenviable reputation for fevers along the course of the river; not only is this true of the immediate borders of this stream, but for many miles the air is injuriously affected.

These marshes have been deposited by running water, until, by their rise and the receding of the water, their surface has been exposed to the air, when there commenced a most luxuriant vegetation, which, dying every autumn, elevates the soil upon which it grows.

The bottom of the river is a mass of broken and decaying shells, from particles too small to be seen by the naked eye to some inches in length. These fragments are bedded in a mud that may be said to be fluid, so soft that a pole can be forced into it, by the power of a single man, many feet deep.

6. I am requested to estimate the quantity, character and cost of the excavation necessary to reduce the surface of the river in *low water* one foot, two feet, three feet, four feet, five feet and six feet. To determine these questions with anything like accuracy, would involve a vast amount of measuring and calculating, for which sufficient time has not been given; but perhaps enough has been done to meet the objects that the Commissioners had in view. To reduce the surface in low water one foot, it would be necessary to move 20,222 yards at Musquito point, which, at 30 cents per yard, would be $6,066; take from Bluff point shoal 111,416 yards, at 10 cents, would cost $11,161; at Hickory island 2,222 yards should be moved, which, at 10 cents, gives $222; in all, $17,440.

To reduce the surface at low water two feet at Musquito point, excavate 35,777 yards, at 30 cents, gives $10,733; at Bluff point and Hickory island 264,487 yards, at 10 cents, amounts to $26,448; at Jack's reefs it would probably be sufficient to cut down the bottom of the canal as proposed, this would cost $9,386; in all $46,557. These calculations are made to answer the interrogations of the Commissioners and *are for low water only*, and to carry 1,400 cubic feet of water per second; in high water such excavations would produce but little effect. The questions in relation to three and four feet have probably been sufficiently

answered. To reduce the water at Montezuma five or six feet would involve the loss of most of the declivity in the stream, as Montezuma is but eight and a half feet above the water in the Baldwinsville pond; and if five feet be deducted, it leaves only three and a half feet fall to be distributed over the whole distance, giving about $\frac{14}{100}$ of a foot to the mile; to reduce the surface six feet, would leave only about a tenth of a foot per mile fall.

Cuts wide enough and deep enough to carry even the least water of summer down so slight a declivity would cost very large sums, as comparatively little mud could be calculated upon as moving under the action of the water. The surface of the water could not probably be kept at these depths if once lowered to them, as in a current so slow the channel would fill up.

7. As to the effect of reducing the water in the river upon the navigable waters connected therewith.

The Erie canal now crosses the river in its waters, but the enlarged canal is in the course of construction, and the aqueduct which is to carry the canal over the river will soon be finished.

The Seneca canal is locked down into the river on both sides, but will probably be carried over it in preference to rebuilding the present dilapidated wooden locks. The Cayuga lake canal is locked into the lake at Cayuga bridge. The present lock is old, of wood, and must soon be rebuilt, and if the lake is lowered it will be necessary to place the foundation to suit the change. Cayuga lake is shallow at its north end, and the wharves at Cayuga bridge, and all the way up the shore as far as Springport, have but enough water to float loaded boats; but these wharves can be extended into deep water with little cost, except at Springport; there any considerable reduction of the lake's surface would make it necessary to dredge out the harbor.

The low lands at the head of the lake would be much benefited by a reduction of even one foot. The whole lake shore would be improved by so deepening the river as to cause the freshets to go at once down it, and thus keep them from raising the lake.

Having, as far as I could, answered the interrogatories put to me by the Commissioners, through you, and having expressed my own views as to the proper plan to be adopted, it only remains for me to add that I herewith transmit to you a map of the river, from the Cayuga lake to Baldwinsville, made from actual

survey. This is the first survey ever made of the river from the lower end of Howland's island to Jack's reefs, so far as I can learn.

The measurements on the surface of the water were made with a line 1,500 feet long, having buoys on it to keep it on the top of the water, and to mark distances. This was drawn on the water by one boat while another was at the other end to hold the line fast to a stake, while a third boat took the soundings and the courses of the river. In order to use the compass it was necessary to push a pole into the mud, and use an arm, made for that purpose, that moved up or down the pole to the proper place, and was then wedged fast. These water measurements were tested at various points upon the monuments set up by a surveyor, who run a line upon the land. This mode of taking the courses of the river was necessary, as it is only at points, sometimes miles apart, that it was practicable to get to the river's edge through the marsh.

So much of the map as shows the country above Howland's island, on the west side of the river, was copied from a map made from a survey of C. A. Olmsted, the present division engineer.

For the purpose of aiding in future observations on the rise and fall of Cayuga lake, benches were made near Cayuga bridge. These benches are cut in the face of the rock on the east shore; one of them is 222 feet southerly from the centre of Cayuga bridge; another is 182 feet southerly from the same place, and a third is 157 feet northerly from the same place. All these benches are on the same level, and are $8\frac{137}{1000}$ feet above the surface of the lake, as it was on the first day of October last.

All of which is respectfully submitted by

Your obedient servant,

GEORGE GEDDES,

Civil Engineer.

Albany, *December* 31, 1851.

State Engineer and Surveyor's Office,
Albany, *January* 8, 1852.

I certify that the within is a true copy of an original report now on file in this office.

WILLIAM J. McALPINE,

State Engineer and Surveyor.

Extra allowances by Canal Board, from 1826 to March 1, 1851.

On contracts, section 3, page 363, Laws 1826	$860,041 49
Additional allowances on appeals from decisions of Canal Appraisers, under act chapter 368, Laws 1829	37,555 63
Additional allowances, miscellaneous, other than appeals, under various acts	24,319 19
For breach of contracts from suspensions, 1842, under act chapter 219, Laws 1843, comprising the whole	514,484 19
Penalties for breach of canal laws remitted	2,114 14
Total, exclusive of canal officers for extra services	$1,438,514 64

Progress of the Canals in 1852.

Total receipts and payments on account of Erie Enlargement, Black River and Genesee Valley Canals, from their commencement to January 21, 1853, as given in the report of the Commissoners of the Canal Fund.

Received:	
From avails of loans	$15,348,230 70
From Erie and Champlain canal tolls	23,036,259 10
From Black River and Genesee Valley canal tolls,	266,095 20
From interest on deposits	299,076 49
From miscellaneous sources	131,266 82
Total receipts	$39,080,928 31
Paid:	
Principal of loans	$3,956,978 33
Interest on same,	9,477,646 07
Interest on revenue certificates	21,540 51
Surplus to Erie and Champlain canals	24,294 48
Canal Commissioners, for construction	24,845,154 27
Superintendents of repairs	346,076 09
Premiums on purchase and investment of stocks,	3,829 25
Collectors	20,357 92
Miscellaneous	385,041 39
Total paid	$39,080,928 31

Tolls, trade and tonnage.

The following interesting table and statements on this subject, are taken from Auditor Newell's report for 1852:

YEAR.	Tons average cargo of boat.	Days' time between Buffalo & Albany.	Freight on a barrel of flour.	Lockages at Alexander's lock.	Tons deliv'd at tide waters from Erie canal.
1841	41	9	71 cents.	30,320	532,520
1844	49	$7\frac{1}{2}$	60 do	28,219	799,816
1847	67	$10\frac{1}{2}$	77 do	43,957	1,431,252
1848	71	9	58 do	34,911	1,184,337
1849	68	$8\frac{3}{4}$	56 do	36,918	1,266,724
1850	76	9	58 do	38,444	1,554,675
1851	78	$8\frac{1}{2}$	49 do	40,396	1,508,677
1852	80	9	53 do	41,572	1,644,699

The above statement gives a comparison of the last year's business with that of 1841; and shows that while the boat has doubled its capacity, the time necessary to make the passage from Buffalo to Albany is the same, at a reduction in transportation of 18 cents per barrel of flour; and that while the lockages have increased 33 per cent., the tons arriving have increased 200 per cent.

Cost of Transportation for the past sixteen years.

Whole cost of transportation on 34,781,919 tons	$78,897,554
Deducting carriers' charges	39,029,692
Leaves	$39,867,862

As a charge or tax upon commerce, beyond the cost of support and maintenance, equal to $1,800,000 per annum for 16 years, and applicable to the payment of interest and principal of the canal debt, and completion of unfinished works.

In 1840, the average charge upon freight, going and returning, was 140 per cent. more than in 1852.

To counteract the effect of repealed railroad tolls, a reduction of 40 per cent. was made in 1852, on merchandise going from tide-water, or from 8 and 5 to 4 mills per ton per mile; and on iron 13.20 per cent., or from $2\frac{1}{2}$ to $1\frac{1}{2}$ mills.

Comparison between the Erie enlargement and railroads, capacity, &c. Taken from Wm. J. McAlpine's report on canals for 1852.

	ERIE CANAL.		Double track railroad, Albany to Buffalo.
	Old canal.	Enlargement.	
Capacity, transport of freight, tons	1,500,000	7,000,000	1,500,000
Cost per mile for construction	$19,679	$80,736	$60,000
Cost per mile for repairs	$900	$700	$600
Cost per mile per ton for movement	$2\frac{1}{4}$ mills.	$1\frac{3}{4}$ mills.	6 mills.
Ratio between cargo and whole weight	1 to 1.43	1 to 1.20	1 to 1.70

Cost of Transportation per ton, per mile, in 1852.

Ocean—long voyage $1\frac{1}{2}$ mills, short voyage 2 to 6 mills.

Lakes—long voyage, 2 mills, short voyage, 3 to 4 mills.

Rivers—Hudson, $2\frac{1}{2}$ mills, St. Lawrence and Mississippi 3, and tributaries, 5 to 10 mills.

Canals—Erie enlargement, 4 mills; others equal in size but shorter, 5 to 6 mills; ordinary size 5 mills; ordinary size with great lockage, 6 to 8 mills.

Railroads—Transporting coal, 6 to 10 mills; not for coal favorable lines and grades, $12\frac{1}{2}$, and for steep grades, &c., 15 to 20 mills.

(The above deductions were made by Wm. J. McAlpine, from extensive tables furnished.)

The following statement was carefully prepared by R. F. Lord, chief engineer of the Delaware and Hudson canal, previous to and as a basis for its enlargement.

Cost of transportation.

Old canal before enlargement, 50 tons 108 miles, $1 per ton, or 1 cent per ton per mile.

For 100 tons 108 miles, 65 cents per ton, or 5 6-10 mills per ton per mile.

For 116 tons 108 miles, 58 cents per ton, or 5 4-10 mills per ton per mile.

For 136 tons 108 miles, 50 cents per ton, or 4 6-10 mills per ton per mile.

The enlargement was made for the last size of boat at a cost of $2\frac{1}{2}$ millions, and the reduction in cost of transportation has been realized.

Estimated cost to complete the canals, by Wm. J. McAlpine, 1852.

CANALS.	TO COMPLETE.	
	On plans and locations, 1851.	On plans and locations, 1852.
Enlargement Erie canal, at contract prices.	$9,648,348 49	$9,577,654 94
Black River canal, do	262,630 18	203,115 00
Oswego canal, do	491,676 00	491,676 00
Genesee Valley canal, do	387,466 74	387,466 74
Total	$10,790,121 41	$10,659,912 68

Progress of the Canals in 1853.

The law for the enlargement of the Erie and completion of the Black River and Genesee Valley canals, and enlargement of the Oswego, passed April 14, 1852, and appropriated $11,585,955, but was repealed by act passed June 29, 1853.

The act, passed July 20, 1853, for the completion of the canals, appropriated—

For the enlargement, as approved by the Constitution	$390,000
do completion Black River canal	75,000
do do Genesee Valley canal	100,000
do improvement Oswego canal	50,000
do enlarging locks, Cayuga and Seneca canal	20,000
do do do Champlain do	10,000
do upper level, Crooked Lake do	5,000

Tolls, Trade, and Tonnage.

The average rate of toll in 1853 was 4.6 mills per ton per mile, for the whole tonnage, 2.4 mills for the products of the forest, 4.1 for animals, 5.5 for vegetable food, 5.2 for manufactures, except salt, 6.2 for merchandise, and 2.6 mills per ton per mile for all unenumerated articles.

TABLE *of Charges.—Actual cost 2-3 of charges.*

	To Liverpool.			To Havre.			To Havana.			To Rio Janeiro.		
	Miles.	Per ton.		Miles.	Per ton.		Miles.	Per ton.		Miles.	Per ton.	
		Voyage.	Per mile.		Voyage.	Per mile.		Voyage.	Per mile.		Voyage.	Per mile.
			Mills.			Mills.			Mills.			Mills.
From Quebec	2,910	$11 00	3.75	3,130	....	....	1,960	....	....	6,010	....	....
Boston	3,020	5 25	1.74	3,000	$5 00	1.67	1,480	$4 00	2.70	5,310	$4 00	0.75
New York	3,150	5 00	1.60	3,318	4 50	1.35	1,250	3 00	2.40	5,240	4 00	0.76
Philadelphia	3,295	5 50	1.70	3,385	5 00	1.47	1,220	4 00	3.27	5,000	5 00	1.00
Baltimore	3,530	5 75	1.60	3,620	6 00	1.65	1,215	5 00	4.11	5,000	6 00	1.20
Richmond	3,395	6 00	1.70	3,485	6 00	1.72	1,170	5 50	4.70	5,000	6 00	1.20
New Orleans	4,755	7 50	1.60	4,845	7 50	1.54	595	4 00	6.72	6,555	7 00	1.06

The rates of freight specified may be considered (they are as far as ascertained) a fair average freight of vessel's capacity for the past three years. To Rio Janeiro the freights are low proportionately, as the return freights are generally good.

By applying the rates given in 1852 to the transportation of freight between the eastern end of Lake Erie and the Atlantic ports, we arrive at the cost for the several routes, as follows:

1st.	By Welland canal, Lake Ontario, and Oswego and Erie canals enlarged, and Hudson river*	$2 43
2d.	Erie canal enlarged and Hudson river, to New York	2 52
3d.	the Canadian canals and the St. Lawrence, to Quebec	2 58
4th.	the Welland canal, Lake Ontario, the Oswego and Erie canals, and the Hudson river, to New York	2 94
5th.	the Erie canal and the Hudson, to New York	3 16
6th.	Welland canal, Lake Ontario, St. Lawrence, proposed Caughnawaga canal, Champlain lake and canal, and the Hudson, to New York	3 43
7th.	the New York Central railroad and the Hudson river	6 19
8th.	the Welland canal, Lake Ontario, the Ogdensburgh and Massachusetts railroads	8 02
9th.	the New York and Erie railroad, to New York	8 43

Analysis of the present business of the New York Canals.

Items.	Per centage of the whole—1852.		Per centage of the whole—1853.	
	Tonnage.	Tolls.	Tonnage.	Tolls.
Of all the canals	100	100	100	100
Of the Erie	.55	.89	.52	.75
Champlain	.13	.04	.14	.03
Oswego	.18	.03	.18	.03
Cayuga and Seneca	.02	.01	.01	.02
Chemung	.05	.00	.06	.04
Crooked Lake	.01	.00	.01	.01
Chenango	.01	.01	.02	.00
Genesee Valley	.03	.01	.04	.02
Black River	.01	.00	.01	.00
Oneida Lake	.01	.00	.01	.00
Of all the canals	100	100	100	100

* To the cost of the movement, in each of the above cases, has been added a price per ton, which would, on a movement of two millions of tons per annum, pay the annual cost of maintenance and interest at 7 per cent. on the cost of the artificial works through which the several routes pass. In the case of the enlargement of the Erie canal, the movement is taken at four millions of tons, in consequence of its greater capacity.

Items.	Per centage, 1852. Tonnage.	Tolls.	Per centage. 1853. Tonnage.	Tolls.
Arriving at tide water	.58	--	.59	--
Leaving do	.13	--	.14	--
Shipped elsewhere	.29	--	.27	--
Of all the canals	100	100	.00	100
Shipped at Hudson river	--	--	--	--
Lake Erie	.19	--	.19	.27
Oswego	.09	--	.12	.13
Whitehall	.03	--	·08	.02
on Chemung canal	--	--	.06	.04

Of the length of navigation by lakes, rivers, and canals, west of, and in the State of New York.

	Area square miles.	Miles wide.	Miles long.
Ontario	6,300	40	180
Erie	9,600	80	270
Detroit river	-----	--	25
St. Clair	360	25	20
St. Clair river	-----	--	32
Huron	20,400	100	270
Georgian bay			
Mackinaw straits	-----	--	---
Michigan	22,400	83	340
Green bay	2,000	--	---
St. Mary's river	-----	--	46
Superior	32,000	135	420
Total length of lake navigation			1,603

The whole length of the lake coast is 5,000 miles, of which 3,000 is in the United States.

	Miles.
Erie	364
Chenango	97
Black river—Rome to High falls (completed 33 miles)	47
do improvement to Carthage	42
Oneida lake	6
Oneida river improvement	20
Oswego	38
Cayuga and Seneca	23
Crooked lake	8
Chemung canal and feeder	23
do feeder	16
Genesee Valley, (completed 88 miles)	118

	Miles.
Champlain canal	64
Glens Falls feeder	15
Length of State canals	877
Delaware and Hudson canal	108
Junction canal to the Chemung	12
Total length of canals	997

Progress of the Canals in 1854.

Act chap. 329, April 15th, 1854, authorized: the enlargement of the prism of the Cayuga and Seneca canal, (the enlargement of the locks having been authorized of wood by act chap. 453, Laws of 1836, and composite by chap. 348, Laws of 1847;) enlargement of the prism of the Oswego canal, (the locks having been authorized to be enlarged by act chap. 262, Laws of 1847;) the completion of the enlargement of the Erie, Black River, and Genesee Valley canals; enlarge-ment of Champlain canal locks; establishing a general system for letting contracts; giving bonds, and reserving 15 per cent. from estimates, &c.; and appropriating for the canals $2,250,000.

This act also created the Contracting Board, composed of the State Engineer and Surveyor and the three Canal Commissioners, (powers extended by act passed March 14th, 1857, to take effect Jan. 1st, 1858, adding the Auditor, and giving the Board the appointment and control of the Engineer Department.

SUMMARY

Of work put under contract on the several canals in this State, in pursuance to act, chap. 329, *Laws of* 1854, *also showing the per cent. less than the engineer's estimate at which the same was awarded.*

ALBANY, *January* 22, 1855.

NAME OF CANAL.	Aggregate of bid.	Engineer's esti'e.	Difference.	Per cent
Erie, Eastern Division	$729,262 75	$965,187 24	$235,924 49	24.433
Erie, Middle Division	932,775 13	1,142,207 73	209,432 60	18.336
Erie, Western Division	2,860,404 50	3,815,666 52	955,262 02	25.035
Total Erie	$4,522,442 48	$5,923,061 49	$1,400,619 11	23.647
Champlain	146,651 58	169,905 54	23,253 96	13.686
Black River	131,910 60	144,030 00	12,119 40	8.414
Oswego	666,521 20	746,341 16	79,819 96	10.695
Cayuga and Seneca	338,153 45	421,923 82	83,770 37	19.854
Genesee Valley	104,075 00	123,350 00	19,275 00	15.626
Total	$5,909,754 21	$7,528,612 01	$1,618,857 80	21.509

Letting out of Repairs by Contract.

The system of repairs by superintendents, under the supervision and personal inspection of the Canal Commissioners, was adopted in 1826 on the completion of the Erie and Champlain canals, and pursued without interruption 28 years, until 1854, when the abuses became so open and palpable as to attract the attention of the Legislature, and laws were passed in 1854 and 1855 authorizing the letting of the repairs of the completed superintendents' sections by contract. In 1854, when the first of these laws was enacted, the cost of repairs had reached the enormous sum of $1,237,866.20, or $1,465 per mile. Under the authority conferred by the above acts, the Canal Commissioners, previous to January 1st, 1856, put under contract for repairs superintendents' sections Nos. 1 and 8, Erie canal; sections 1, 2, and 3, Champlain canal; sections 1 and 2, Black River canal; sections 1, 2, and 3, Chenango canal; sections 1 and 2, Genesee Valley canal; the Chemung, Crooked Lake, and Oneida Lake canals.

Charles Cook and Wm. J. McAlpine made a proposition to take the repairs of the canals by contract for $700,000 a year, as stated by Mr. Field in a report from the committee on canals, when introducing the bill for letting the canal repairs by contract.

Cost of completing the canal; by Jno. T. Clark, in 1854, *and Wm. McAlpine, in* 1852.

CANALS.	By Jno. S. Clark, Jan. 1855.	By W. J. McAlpine, Jan. 1853.
Erie canal enlargement	$9,136,842 86	$11,168,772 94
Oswego canal enlargement, locks and channel	1,218,763 22	1,462,833 00
Cayuga and Seneca canal, do	590,908 13	632,000 00
Black River canal, and improvement to river	344,970 65	521,545 36
Genesee Valley canal	245,086 00	486,466 74
Enlargement of locks on Champlain canal	264,291 49	264,291 49
Add for engineering, land damages and building	1,500,000 00	$14,535,509 53
Deduct amount done from Jan. 1853, to Jan. 1855		2,069,962 26
Totals	$13,300,862 35	$12,465,947 27

The Erie canal has been shortened by enlargement 13.06 miles, as follows: on the Eastern division, 1.26 miles; Middle division, 4.17 miles; and Western division, 7.63 miles.

Chemung Canal.

In answer to a Senate resolution, Jan. 9th, 1855, the State Engineer stated that the present locks on this canal had been in

use 14 years, and that one-third of the whole should be rebuilt before the spring of 1856; that the estimated cost of rebuilding the same on the old foundations of wood would be $5,500 each, that composite locks would cost $7,500, and enlarged composite (same as on the Cayuga and Seneca canal) would each average from $18,000 to $20,000.

Acts passed during the year.

To amend the Constitution for the completion of the canals, chap. 5, Jan. 20; to improve the Erie, Oswego, Cayuga and Seneca canals, for boats 3½ feet draught, chap. 16, Feb. 15; to pay for materials delivered and used by superintendents, chap. 202, April 13; to connect the Junction canal with the Chemung canal, chap. 227, April 15; prescribing regulations and management of canals, chap. 331, April 15; Baldwinsville canal placed under control Canal Board, chap. 333, April 15; law for completion of canals passed July 10th, 1851, repealed, chap. 338, April 17.

Reduction rates of tolls.

ARTICLES REDUCED.	Amount of reduction. from	to	Toll on articles in 1851 reduced in 1852.	Toll on same articles at rates of '52.	Difference in toll collected on articles reduced.	Per cent of reduction on articles reduced.
	mills.	mills.				
Merchandise	8	4	$454,378	$227,189	$227,189	50
do	5	4	257,049	205,639	51,410	20
Railroad iron	2.5	1.5	120,614	72,369	48,245	40
Down freight	......	......	489,017	385,250	112,767	22.64
			$1,330,058	$890,447	$439,611	33

Between the years 1851 and 1852 the per cent. of reduction on all merchandise reduced from 8 and 5 mills to 4 mills was	39.16
Per cent. of reduction in total tolls ($3,329,777) for season of navigation	13.20
Per cent. of reduction in tolls on down freight	4.515

PROGRESS OF THE CANALS IN 1855.

Completion of the Canals: Statements from the Report of John T. Clark, State Engineer and Surveyor.

Estimated cost of all the canals from and after the 31st day of December, 1853, the constitutional amendment having been sanctioned by the people in February, 1854.

Work done in 1854		$873,713 84
do in 1855		3,524,898 03
Expenditures in the Engineer Department in 1854		144,136 43
do do do 1855		211,982 72
Required to complete the Erie canal enlargement at contract prices, from and after the 31st of Dec., 1855	$4,823,727 98	
do Oswego canal	837,311 59	
do Cayuga and Seneca canal	321,133 96	
do Black River canal	222,359 03	
do Genesee Valley canal	96,989 30	
do Locks on Champlain canal	132,185 16	
	$6,433,707 02	
Add for contingencies, 10 per cent.	643,370 70	
	$7,077,077 72	
Engin'g, land damages, &c., (est'd)	1,300,000 00	
		8,377,077 72
Estimated cost of all the canals, from the 31st day of December, 1853		$13,131,808 74

The following summary shows the estimated cost of each canal from and after the 31st December, 1855, with 10 per cent. added for contingencies:

Erie canal	$5,306,100 77
Oswego canal	921,042 75
Cayuga and Seneca canal	353,247 35
Black River canal	244,594 93
Genesee Valley canal	106,688 23
Locks of the Champlain canal	145,403 67
	$7,077,077 70
Add for engineering, land damages, removal of buildings, and miscellaneous expenses	1,300,000 00
	$8,377,077 70

Statement showing the present estimated cost of completing the New York State Canals, from January 1st, 1854; the amount each canal would be entitled to receive on a pro-rata division, in proportion to said cost, of the $9,000,000; the amount appropriated to each in 1854 and 1855; and the amount each canal would be entitled to receive on a pro-rata division, as aforesaid, of the appropriation of the remainder of the nine millions, at the present session of the Legislature, at contract prices, and exclusive of land damages and engineering.

	Present estimated cost of completing, from January 1, 1854.	Amount each canal would be entitled to, to make up the $9,000,000.	Amount of appropriations made in the years 1854 and 1855.	Amount which each canal is entitled to receive from appropriations to be made in the year 1856.
Enlargement of the Erie canal	$8,540,775 09	$6,672,928 50	$5,547,000 00	$1,125,928 50
do of the Oswego canal	1,468,053 94	1,146,994 15	527,000 00	619,994 15
do of the Cayuga and Seneca canal	543,733 00	424,819 92	301,000 00	123,819 92
Completion of the Black River canal	395,391 01	308,919 97	147,000 00	161,919 97
Completion of the Genesee Valley canal	299,158 57	233,733 32	163,000 00	70,733 32
Enlargement of locks of Champlain canal	272,115 04	212,604 14	75,000 00	137,604 14
Totals	$11,519,226 65	$9,000,000 00	$6,760,000 00	$2,240,000 00

All of which is respectfully submitted.

HENRY FITZHUGH, *Canal Commissioner.*
S. SEYMOUR, *State Eng. and Surveyor.*

The Letting of Canal Repairs by Contract.

The Legislature, by act, chap. 327, Laws of 1854, authorized the Canal Commissioners, under the direction of the Canal Board, to let by contract to the lowest responsible bidder, not to exceed three superintendents' sections of the enlarged Erie canal.

But two such sections were at that time completed; one of them, section No. 8, extending from the Limestone creek feeder in Manlius to the foot of lock No. 50, four miles west of Syracuse, a distance of eleven (11) miles, was put under contract for five (5) years from the 1st of October, 1854; the other section, No. 1, at Albany, was put under contract last spring, for five years from the 1st of March last.

Last winter the Legislature, by act, chap. 554, authorized the letting by contract of the repairs of any of the completed sections of the canals not already under contract. Under this act the Chenango, Crooked Lake, and Oneida Lake canals, and the Chemung canal and feeder, all on the Middle division, were put under contract in September, for five (5) years from the 1st of October last; the Genesee Valley, in December last, for the same period from the 1st of February next; and the Black River and the Champlain canals for the same period of time from the 1st inst.

Progress of the Canals in 1856.

Completion of Canals—From Silas Seymour's report for 1856.

The following estimate is now submitted to the Legislature as the most reliable one that can be formed of the total cost (from and after the 31st December, 1853) of the "enlargement of the Erie, the Oswego, the Cayuga and Seneca canals, and the completion of the Black River and Genesee Valley canals, and the enlargement of the locks on the Champlain canal," as provided for in the amendment to the Constitution, adopted on the 14th day of February, 1854:

Work done in 1854	$873,713 84
Engineering do	144,136 43
Land payments do	82,946 44
Work done in 1855	3,524,898 03
Engineering do	211,982 72
Land payments do	92,611 80
Work done in 1856	3,864,014 95

Engineering in 1856	$245,618 48	
Land payments do	134,987 11	
		$9,174,909 80

Estimated cost of work to be done after 31st Dec., 1856.

Erie canal enlargement	$2,936,483 43	
Oswego canal	592,747 05	
Cayuga and Seneca canal	272,038 52	
Black River canal	142,742 60	
Genesee Valley canal	55,600 98	
Locks on Champlain canal	183,746 00	
Estimated cost of engineering	258,902 00	
Estimated land payments required	632,329 62	
		5,075,090 20
Total		$14,250,000 00

The statement of work done and the expenditures in the Engineer's Department, for 1854 and 1855, are taken from the estimates of Mr. Clark, contained in his report for 1855. The land payments for the years 1854 and 1855, are taken from the reports of the Canal Appraisers for those years, and the amount for the year 1856, is the amount of awards for that year, as furnished by the Appraisers, the whole of which has probably not been paid.

Work was partially suspended upon the unfinished canals Oct. 16, 1856, the money provided by the Constitution, and appropriated by the Legislature, being insufficient.

Form of Suspension.

CANAL COMMISSIONERS' OFFICE,
1856.

To —— ——, contractor for the construction of ——— for the enlargement of the Erie canal:

In accordance with a proviso in your contract with the State of New York, made and provided, you are hereby notified that appropriations are exhausted on the ——— division of the enlargement of the Erie canal, for the fiscal year ending Sept. 30, 1857.

The new locks, Nos. 32, 34, 39, 40 and 41, were brought into use the past season.

The dams across the Mohawk, at Rome, and at Rocky rift feeder, were completed; the Rome feeder had been the past season, and the Rocky rift feeder would be completed for use in the coming season.

Tolls, Trade and Tonnage.

The comparative tabular statement, No. 48, herewith submitted, is a condensed view of the total tonnage and receipts of toll on all the canals on the different descriptions of property carried, for the period of six years:

	Tons carried.	Tolls received.	Average per ton.
1851	3,582,733	$3,075,992	$85 86
1852	3,863,441	2,866,385	74 19
1853	4,247,853	2,955,697	69 51
1854	4,165,862	2,547,438	61 15
1855	4,022,617	2,610,420	64 89
1856	4,116,082	2,554,215	62 05

The receipts of toll above given are upon the property carried exclusive of the tolls on boats and passengers.

Acts passed during the year:

Appropriating $60,000 for enlargement Champlain canal locks, April 10, 1856; Genesee Valley canal, authorizing survey for extension from Olean to Millgrove pond, (the survey of which was made and reported on January 24, 1857; the north 7.16 miles long, estimated to cost $106,817, and south line, 6½ miles long, $109,072.)

Progress of the Canals in 1857.

Cost of lateral canals, as given by the Auditor, in answer to Senate resolution, dated April 9, 1858.

CANAL.	A. Cost of original construction.	B. Enlargement, extra repairs, &c.	C. Expense of working canals.	D. Deficiencies included in col'n C, for ordinary repairs.	E. Amounts received from the canals.	F. Contributed from other funds.
Oswego canal	$565,437 35	$1,477,042 74	$1,678,825 03	$526,649 38	$1,776,236 79	$1,945,068 33
Cayuga and Seneca canal	236,804 74	581,960 80	768,209 12	215,273 03	615,214 33	971,760 33
Chemung canal	331,693 57	480,751 04	1,168,260 96	772,073 81	358,342 20	1,622,363 37
Crooked Lake canal	156,776 90	147,269 16	264,505 45	355,272 08	70,694 57	497,856 94
Chenango canal	2,270,605 22	154,763 06	1,833,477 32	1,238,438 27	579,313 93	3,679,531 88
Black River canal	1,068,437 20	1,793,043 39	1,265,021 24	676,134 48	76,095 13	4,050,406 70
Genesee Valley canal	2,002,285 92	3,386,257 04	4,016,440 25	1,385,951 47	618,921 93	8,786,061 28
Oneida Lake canal	50,000 00	....	119,359 28	45,530 85	62,378 43	106,780 85
Baldwinsville canal	16,585 13	....	7,146 26	7,147 63	1,083 76	22,647 63
Total	$6,698,626 03	$8,021,087 23	$11,121,245 11	$5,222,471 00	$4,158,481 07	$21,682,477 31

Cost of original construction as above	$6,698,626 03
Canal Commissioners, for enlargement and extra repairs	8,021,087 23
Total payments by Canal Commissioners	$14,719,713 26
Expense of working canals	11,121,245 11
Gross cost of canals	$25,840,958 38
Deduct amount received from tolls	4,158,481 07
Net cost canals and working same	$21,682,477 31

Statement of the amount of work already done, and estimated cost of completing the works authorized by the Constitution, by Silas Seymour, in report for 1857.

The amount estimated for work done, engineering, land damages, &c., upon the enlargement and other works authorized by the Constitution, from December 31, 1853, to December 31, 1856, was		$9,174,909 80
The amount estimated on the same account during the past year was		2,862,923 07
The estimated amount of work to be done and payments to be made for engineering, land damages, &c., from and after this date, is as follows:		
Erie canal enlargement	$1,743,964 58	
Oswego canal	448,027 37	
Cayuga and Seneca canal	161,677 24	
Black River canal	97,135 00	
Genesee Valley canal	109,212 10	
Locks on the Champlain canal	129,180 00	
Engineering	209,919 00	
Land damages	467,829 62	
Add for contingencies	345,222 22	
		3,712,167 13
		$15,750,000 00

It will be seen by comparing the above estimate with the estimate submitted in the last annual report from this Department, that the present total estimated cost is increased by the sum of $1,500,000 over the estimate of last year.

This increase upon the Eastern division, as reported by Mr. Goodsell, is	$188,573 07
Upon the Middle division, as reported by Mr. Hartwell	233,025 16
Upon the Western division, as reported by Mr. Fay	733,179 55
Total increase, exclusive of contingencies, added to estimate of State Engineer	$1,154,777 78

The plan for the improvement of the Black river by piers and longitudinal dams was abandoned by the Canal Board September 3d, 1857, and a lock and dam at Otter creek substituted.

Cazenovia Lake Reservoir.

Brought into use in the spring of 1857, at a cost of $10,884.73.

Oswego Canal.

The Phœnix dam was raised temporarily 4 feet 2 in. The statute height was 4 feet 3 in. (see Com. Report, 1838.)

Genesee Valley Canal.

The act authorizing its extension to Millgrove pond, chap. 247, Laws 1857, it was estimated to cost at contract prices, including land damages and engineering, $88,333. The law appropriated $109,000, including land damages and engineering, and adopted the south line, six and a half miles long.

Tolls, Trade and Tonnage.

The following statement shows the number of barrels carried on the canals in each of the years named, and the tolls received by the State:

	Barrels.	
In 1851	3,853,472	$646,402
1852	3,773,815	643,240
1853	3,439,389	565,744
1854	1,550,491	222,472
1855	1,569,303	213,692
1856	1,212,231	146,633
1857	850,000	102,816

The following statement shows the aggregate amount of tolls received on all the canals of the State, during the season of navigation, in the years named below, together with the annual

charges for collection and superintendence, and giving the surplus in the third column:

In 1851	$3,329,727 00	$907,730 00	$2,421,997 00
1852	3,118,244 00	1,049,045 00	2,069,199 00
1853	3,204,718 00	1,098,476 00	2,106,242 00
1854	2,773,566 00	1,237,866 00	1,535,700 00
1855	2,805,077 00	989,792 00	1,815,285 00
1856	2,748,212 00	786,633 00	1,961,579 00
1857	2,031,967 00	970,453 00	1,061,514 00

The statement below shows the steady and progressive increase of the freight traffic upon the two lines of railway competing with the canals, for the period of four years, commencing with 1853, when the several railroads constituting the then New York Central line were consolidated:

ROADS.	Total tolls collected on canals, and freight on railroads, in dollars.		Total tolls collected on canals, and freight on railroads, in dollars.	
	1853.	1854.	1855.	1856.
New York Central railroad	$1,838,830	$2,479,820	$3,189,603	$4,328,041
New York and Erie railroad	2,537,214	3,369,590	3,653,002	4,545,782
Total	$4,376,044	$5,849,410	$6,842,605	$8,873,823
Total canal	$3,204,718	$2,773,566	$2,805,077	$2,748,212

STATEMENT

Of receipts and payments on account of railroads, up to the 30th September, in each fiscal year.

YEAR.	RECEIVED.		PAID.			
	Tolls.	Total.	Collectors and Inspectors.	Stock of the Cayuga and Seneca canal	Surplus tolls to E. and C. canals.	Total.
1845	$10,458 44	$10,458 44	$750 00	....	....	$750 00
1846	23,201 89	23,201 89	750 00	$32,160 33	....	32,910 33
1847	38,946 49	38,946 49	750 00	....	$38,196 49	38,946 49
1848	96,160 44	96,160 44	684 42	....	95,476 02	96,160 44
1849	128,534 13	128,534 13	....	....	128,534 13	128,534 13
1850	136,424 92	136,424 92	2,390 62	....	134,034 30	136,424 92
1851	171,055 01	171,055 01	2,247 73	....	168,807 28	171,055 01
1852	56,901 26	56,901 26	1,883 36	....	55,017 90	56,901 26
	$661,682 58	$661,682 58	$9,456 13	$32,160 33	$620,066 12	$661,682 58

Act for Payment of Interest on the 15 *per cent. retained on Suspended Work. Passed April* 17, 1857, *chap.* 734.

This act authorizes the Canal Commissioners to pay interest on the 15 per cent. retained prior to such suspension, from and after 90 days after the time fixed for the completion of the work on all contracts made in pursuance of act, chap. 329, Laws 1854.

The act for abandoning the old canal passed April 6, 1857, chap. 267.

The act to use the Black river for a feeder to the Black River and Erie canal, passed April 3, 1857, chap. 245.

Act, chap. 419, Laws of 1857, authorized the Commissioner to deepen the channel from Waterloo to Geneva, and through the outlet of Seneca lake, to nine feet below the surface of water at Waterloo dam.

Progress of the Canals in 1858.

Black River Canal and river improvement.

In answer to an Assembly resolution, Hon. Van R. Richmond submitted the following report:

The original plan for the improvement of Black river, contemplated the construction of 18 jetty dams and piers, between Beach's Bridge and Lyon's Falls, and the construction of a dam across the river at Carthage. The dam at Carthage, and pier No. 1, was completed, and work commenced on 9 jetty dams. The bulk of expenditures was upon excavation and driving piles. The original estimated cost of this improvement was, at contract prices, $145,839, and in 1838 at $202,800.

The amount expended upon the work was	$87,578 53
do paid for materials not used	14,309 99
do awarded contractors for damages	24,592 24
Total expended	$126,480 76

The substitution of lock and dam at Otter creek was estimated to cost $30,000.

2d Reservoirs.

RESERVOIR.	Area reservoir.	Estimated cost.	Amount expended.	Amount damages.	Cost to complete original plan.	To complete without clearing flow gr'dg.
	Acres.					
North branch..	423	$34,636 92	$36,205 07	$4,105 08	....	....
South branch..	518	19,750 00	9,129 51	2,211 00	$17,500 00	$11,500 00
Chub lake	530	27,700 00	8,185 46	3,000 00	37,000 00	28,200 00
Woodhull......	1,236	18,550 00	11,789 50	*4,000 00	5,000 00	1,200 00
	2,707	$100,636 92	$65,309 54	$13,316 08	$59,500 00	$40,900 00

* Claimed.

(These contracts were abandoned September 3, 1857.)

The quantity of water diverted from Black river, was 14,000 cubic feet per minute, of which 3,000 cubic feet was returned, leaving 11,000 diverted. The reservoirs will furnish 16,000 cubic feet per minute for 110 days. The available quantity at head Moose river is 800,000,000 cubic feet per year.

The amount expended during the year, for construction	$1,558,849 14
Awards of Canal Appraisers	200,000 00
Engineering	124,790 06
Total	$1,883,639 20

The estimated cost to complete the canals, from January 1, 1859, exclusive of land damages, by Hon. Van R. Richmond, was

for the enlargement of the Erie	$995,525 23
Enlargement of the Oswego canal	333,173 12
do Cayuga and Seneca canal	162,750 06
do locks on Champlain canal	104,700 00
Black River canal	151,110 00
Genesee Valley canal	30,320 00
do do do extension	41,050 00
Engineering 10 per cent	181,862 84
	$2,000,491 25
Add for contingencies	200,049 12
Total	$2,200,540 37

During the year 166 contracts were completed and settled, amounting to $4,441 914.35. One hundred and thirty-five con-

tracts were still in existence. Estimated amount of work included in above to complete, not under contract, $765,916 24.

Chemung Canal.

The rebuilding of the locks for the second time since the completion of the canal was commenced, and eight brought into use in the spring of 1858, at an average cost each of $8,484. The first set were rebuilt and brought into use in the spring of 1842, at an average cost each of $5,430. The original set was brought into use with the completion of the canal, September 10, 1831, at an average cost each of $1,650. The average age of the original set was eight years, and second set sixteen years. An act was passed April 14, 1858, chap. 211, for the enlargement of the locks on this canal, after the completion of the enlargement of the Erie; the locks to be composite.

Improvement of the Owasco Lake outlet.

This work was authorized by act, chap. 139, Laws 1852. Its object was to make a reservoir of the lake, to insure a full supply of water for the machinery of the Auburn State prison in the dry seasons.

The following appropriations have been made for this work:

By the Legislature of 1852	$7,000 00	
do do do 1853	6,485 00	
do do do 1855	10,000 00	
do do do 1857	10,000 00	
do do do 1858	3,179 56	
Total		$36,664 56
There has been paid to O. C. Hubbard, by estimates	$13,923 11	
There has been paid to J. H. Ledlie, by estimates	20,650 56	
There has been paid for engineering and contingencies	1,722 12	
Total		36,295 79
Leaving balance unexpended		$368 77

Tolls, Trade and Tonnage.

The whole railway investment, including stock, floating and funded debt, was $149,162,311.81 on the 30th of September last, and this, of course, includes the accommodation for passenger

business as well as the freight traffic. The earnings of all the roads on their freight business was $10,532,714.97, and the cost of operating the roads, or expense of carrying on this traffic was $6,254,049.15, excluding the city roads, leaving, as the net earnings of the roads, $4,278,665.82. This sum, divided by the total movement, or number of tons carried one mile, gives an average of 1.017 cents a ton per mile net, while the gross canal receipts for the year, without any deductions for repairs and collections, were only 3.71 mills a ton per mile on the total canal movement.

The average cost of transporting fifty tons of freight through to Chicago by all rail, at published rates, would be $1,116, while by river, canal and lake, that cost would be less than four hundred dollars. The average charge per ton per mile by all rail, on the shortest or Cristline route to Chicago, is 2 45-100 cents, while by lake, canal and river the charge, according to the highest rates given, would not exceed 4 62-100 mills per ton a mile.

The following table of distances has been carefully compiled, and shows the miles by railroad from Baltimore, Philadelphia, New York and Portland, on the Atlantic, to Chicago, the grain mart of the west, and other competing points in the lake country.

The water distance from Buffalo to Chicago is 916 miles, which at the highest lake rates, compared with rail rates, is only equal to about 112 miles of railroad distance in cost of transportation:

		Miles.
From New York to Chicago, by the Pennsylvania railroad, through Pittsburg, Cleveland and Toledo		935
From New York to Chicago, by the New York and Erie, Lake Shore, and Michigan Southern railroads		957
From New York to Chicago, by the New York Central, Great Western of Canada, and Michigan Central railroads		957
From New York to Baltimore	186	
From Baltimore to Cincinnati, by the Baltimore and Ohio, and Central Ohio railroads	632	
From Cincinnati to Chicago	310	
		1,128
From New York to Philadelphia	88	
From Philadelphia to Pittsburg	358	
From Pittsburg, by Cristline, Fort Wayne, to Chicago—the new route	465	
		911

		Miles.
From Portland to Detroit, by Montreal, Toronto and Hamilton, Canada West	851	
Detroit to Chicago, *via* Michigan Central railroad	282	
		1,133
From Detroit to Albany, by Great Western, Canada, and New York Central railroads	533	
From Albany to New York, by river or railroad	150	
		683

The water lines connected with the New York Central railroad make the rail distance to Chicago less than 450 miles, and in connection with the New York and Erie *via* Dunkirk, that distance is about 570 miles, in cost of transportation at established rates. Hence it costs no more to carry a ton of freight from New York to Chicago by river, canal and lake, 1,425 miles, at the rates above given, than the rail carriage on 270 miles will cost.

The foregoing statements are brought into a tabular form, in order to present the same at one view to the reader.

Cost per ton from Baltimore to Chicago	$23 07
Cost per ton from Philadelphia to Chicago	20 16
Cost per ton from New York to Chicago, by New York and Erie railroad	13 38
Cost per ton from New York to Chicago; by New York Central railroad	10 82
Cost per ton from New York to Chicago, by New York canals, &c	7 12

The property, of every description, carried on the canals in 1838, was 1,337,357 tons, and paid in tolls $1,588,357. The amount carried in 1856 (which is selected in preference to 1857, a year of unusual depression), was 4,116,087 tons, and paid in tolls $2,748,203. These figures show at once the great reduction in the rates of toll; being from $1.20 per ton in 1838, to 66 cents per ton in 1856.

Progress of the Canals in 1859.

Champlain Canal.

The Hon. Van R. Richmond, in answer to a Senate resolution dated January 21st, 1859, reported that the estimated cost to make 5 feet depth of water in the Champlain canal was $167,645, and Glens Falls feeder $52,690; total $200,335.

Chemung Canal.

In answer to a Senate resolution, the Canal Commissioner in charge and Lieut.-Governor, a committee appointed by the Canal Board, reported, February 24, 1859, that there were two stone locks constructed upon the Chemung canal; No. 2 cost $15,856, and No. 3 $15,477; that there were 54 locks upon the canal and feeder, which to reconstruct of stone would cost, at above prices, three-quarters of a million dollars; that the lock by which the trade of the Chemung passes into the Erie canal, passes about one-third as many boats as by the locks west of Montezuma junction on the Erie, and one-half as many as passed on the Champlain canal, and two-thirds as many as the Oswego canal; also, that the average receipts of this canal, from 1853 to 1857 inclusive, were $18,000 per year, which, on 200 miles, would amount to $120,000; that this canal became the outlet of the Pennsylvania canals by its connection with the junction canal lately completed, thus reaching into the vast deposits of anthracite and bituminous coal of that State.

Oswego Canal—its cost.

The State Engineer and Auditor, in answer to a Senate resolution, February 14, 1859, reported: That the original estimated cost of the Oswego canal, when commenced, was $437,000, and its cost when completed was $565,437.35; that the total expenditure up to 1854 were as follows, viz:

By Canal Commissioners, for construction, enlargement and extra repairs	$934,334 80
By superintendents of repairs	808,192 86
Paid collectors and inspectors	71,957 36
interest on loans	427,395 54
miscellaneous payments	22,426 20
	$2,264,306 76

The estimate for enlarging and completing in 1854 was $1,218,763.22.

There has been paid on account of said enlargement and completion, from 30th Sept., 1853, to Oct. 1st, 1858	$1,289,709 89
Amount outstanding drafts for work on same, Oct. 1st, 1858	$168,351 64
Total	$1,458,061 53

Estimated cost to complete from and after January last, was $333,173.12.

The total expenditures on this canal up to October 1st, 1858, as follows:

By Canal Commissioners for construction of enlargement and extra repairs		$2,224,044 69
By superintendents of repairs		1,180,438 28
Paid collectors and inspectors		102,310 73
Paid interest on loans		487,395 54
Miscellaneous		26,441 08
Unpaid drafts		168,351 64
Total payments		$4,188,981 96
And the whole receipts to Sept. 30, 1858, as follows:		
For premiums on loans	$21,690 00	
tolls, commencing in 1828	1,558,712 13	
sales of land	213,087 97	
rent surplus water	6,370 53	
miscellaneous receipts	60,403 25	
		1,860,263 88
Excess of payments over receipts		$2,328,718 08

Lengthening enlarged locks.

Van R. Richmond, State Engineer, in answer to a Senate resotion, estimated the cost of lengthening 22 single, 53 double, 5 double combined, 2 guard and 5 weigh locks, on the Erie canal; and on the Oswego canal, 19 single and 5 guard locks, (after taking down 20 feet at upper ends,) 33 feet on extension of foundations, as follows, for a boat 130 feet long:

Lengthening	53	single locks at $6,000 each	$318,000
do	53	double locks at $12,000 each	636,000
do	7	guard do $5,000 do	35,000
do		combined locks at Lockport	225,000
do	5	weigh locks, including scales	50,000
			$1,264,000

And the same for slide gates at head (if practicable) $418,200.

Hon. Van R. Richmond estimated the cost to complete the enlargement of the Erie canal after Jan. 1st, 1860, exclusive of

land damages, at	$535,626 30
Completion of lateral canals	494,060 39
Contingencies	150,000 00
Total	$1,179,686 69

showing a diminution in the estimates of the cost to complete, as compared with last year, of $46,039.69.

Black River Canal.

This canal is entirely completed from its junction with the Erie to its entrance into the Black river at Lyon's Falls. The dam and lock at Otter creek were put under contract the past year, (at an estimated cost, at contract prices, of $27,309,) also the Woodhull and South branch reservoirs.

Interest on Canal Drafts.

By the act, chapter 149, Laws of 1859, the Legislature appropriated $125,000 to pay the accrued and accruing interest on drafts drawn by the Canal Commissioners for work done on the canals, for damages awarded by the Canal Appraisers, and for awards made by the Canal Board, and to pay the interest on damages awarded by the Canal Appraisers, the Canal Board, and Board of Canal Commissioners, previous to the first day of Jan'y, 1859, for which drafts had not been given, and to pay the interest on the temporary loan of $200,000.

Tolls, Trade, and Tonnage.

The following statement shows the number of tons of through freight carried by the New York Central railroad during the three years named, the earnings therefor, and the average receipts per ton each year:

1857	Tons carried,	292,877	Receipts,	$2,518,785 93	Av. ton,	$8,60.00	Decrease.
1858	do	312,408	do	2,125,726 85	do	6,80.43	$1,79.57
1859	do	348,079	do	1,995,572 07	do	5,73.28	1,07.15

Carrying, in 1859, 55,202 tons more than in 1857, the receipts of the road were $523,213.86 less. The road carried 35,671 tons more in 1859 than in 1858, and the receipts were $130,154.78 less.

The effect of the competition of the two great southern lines, upon the traffic of the New York Central, will be well illustrated by giving the prices charged and received per ton for through freight on those lines. In 1859, the Pennsylvania railroad carried 221,210 tons through freight, and received $8,09.62 average per ton. The Baltimore and Ohio railroad, in 1858, carried 224,863

tons of through freight, and received $7.34 per ton of 2,000 pounds, average.

Comparative statements of the movement of freight on the two railways connecting New York with Lake Erie, and the State canals, during the last four years, showing the tons carried each year, the total movement, or number of tons moved one mile, and the freight and tolls received therefrom.

	1856.	1857.	1858.	1859.
Tons carried by railway	1,719,327	1,816,857	1,582,371	1,703,392
Tons carried by canal	4,116,082	3,344,061	3,665,192	3,781,684
Aggregate of both	5,835,409	5,160,918	5,247,563	5,485,076

STATEMENT *showing the tons of each class of property transported on the New York Central, and the New York and Erie Railroad, and on the New York Canals, during the year* 1859.

	The forest.	Product of animals.	Vegetable food.	Other agricultural products.	Manufactures.	Merchandise.	Other articles.	Total.
New York C. RR.	35,154	205,167	249,751	30,096	57,036	178,782	79,333	834,319
N. Y. and E. RR.	97,754	170,322	112,727	15,107	94,266	179,050	199,846	869,072
	132,908	374,489	362,478	45,203	151,302	357,832	279,179	1,703,391
N. Y. State canals	1,542,035	36,151	773,655	6,978	299,421	211,182	912,262	3,781,684
Excess by canals.	1,409,127	....	411,177	......	148,119	....	633,083	2,601,506
Excess by railr'ds,	....	338,338	....	38,225	....	146,650	....	523,213
Total excess by c'ls	....	....	....	......	....	....	....	2,078,293

Canadian Canals.

A comparative statement of the tonnage of goods and property which passed through and on the undermentioned canals in Canada, for the years mentioned below, distinguishing the up and down trade.

	Welland Canal.				St. Lawrence Canal.			
	1855.	1856.	1857.	1858.	1855.	1856.	1857.	1858.
Tonnage up	229,012	276,919	245,256	195,144	122,205	131,430	134,382	110,807
Tonnage down	629,321	699,637	655,816	659,968	419,049	503,106	459,270	494,751
Total tonnage up and down	849,333	976,556	901,072	855,112	541,254	634,536	593,652	605,558

Aggregate of up tonnage on the Welland canal	937,331
Aggregate of down tonnage on the Welland canal	2,644,742
Total movement for four years on Welland canal	3,582,073
Aggregate of up tonnage on St. Lawrence canal	498,824
Aggregate of down tonnage on St. Lawrence canal	1,876,176
Total movement for 4 years on St. Lawrence canal	2,375,000

Of the total tonnage, 852,671, which passed through the Welland canal in 1858, there was shipped from Canadian to American ports

ports		93,649	tons.
From American to American ports		482,767	do
Total American tons		576,416	
From Canadian to Canadian ports,	155,624 tons.		
From American to Canadian ports,	120,631 do		
Total Canadian tons		276,255	
Total tons		852,671	

Showing two tons of American traffic to one ton of Canadian, through this canal.

Of the total tonnage, 605,558, which passed through the St. Lawrence canal in 1858, there was shipped from Canadian to Canadian ports

Canadian ports		546,798	tons.
From American to Canadian ports		14,538	do
Total Canadian tons		561,336	
From Canadian to American ports,	44,193 tons.		
From American to American ports,	29 do		
Total American tons		44,222	
Total tons		605,558	

Of this movement in Canadian waters, 837,591 tons were Canadian, and 620,477 tons were American; aggregate of both, 1,458,629 tons.

Acts passed during the year.

The Canal Board to cancel contracts, only when the State has failed to make payments, on the application of the contractor;

passed April 19, 1859; chapter 495. This law also abolished assistant collector and appointed Inspectors; also invested the clerk of the Contracting Board with power of commissioner of deeds.

The act authorizing the Auditor to act in place of a disqualified Canal Commissioner, passed April 15, 1859, chap. 376. The act to lay a railroad track on the berme bank of the Chenango canal, passed April 19, 1859, chap. 501.

Plans of Canal Structures.

During the last term of State Engineer and Surveyor Richmond's administration, numerous complaints were made that but few correct copies of original plans could be found in the principal engineer's offices along the line of the canal. To avoid future embarrassment, S. H. Sweet, resident engineer at Syracuse, was directed to prepare and perfect a set of the principal plans in use on the canals, for publication. In absence of correct plans, he obtained the dimensions from structures already built. The following is a list of the structures so prepared and published, and accompanied Mr. Richmond's annual report for 1859, drawn on scales of from six to eight feet to an inch, to which have been added the designing engineers, and the average cost of each:

General plans—Kind of structure.	Size.	Designing engineer.	Cost each by contract.
Timber locks	93½ x 16	No. 1, Van R. Richmond, No. 2, Van Vleck & Sweet.	$8,200 00
Wood bridge superstructure	72 span x 14	Squire Whipple.	420 00
Seneca River aqueduct	894½ trunk	Van R. Richmond.	200,000 00
Iron arch bridge	72 ft. span	1 roadw'y & 2 s'walks, S. Whipple	1,700 00
do	100 do	do do Sq. Whipple.	2,325 00
Iron trapezodial truss	120 do	1 roadway, Squire Whipple.	
Dam and bulkh'd RR feeder	360⅔ x 6	D. C. Jenne & Wm. B. Taylor.	23,000 00
Enlarged double locks	172½ x 18	Jervis, Hutchinson, Barrett, Mills & Childs.	73,850 00
Beardslee b'dge iron chord.	72 ft. span	Iron-combination, by S.H.Sweet.	500 00
Composite locks	90 x 15	Van R. Richmond & O.W. Childs.	10,000 00
Bridge, wood, lateral canals.	50 x 12	S. H. Sweet.	260 00
Waste weir	100 waste	Jervis, Hutchinson, Mills, Childs.	6,320 00
Composite lock valve	8 for 1 lock	Jno. Beardslee, pr. valve.	30 00
Plans of culverts	2 arches x 10 ch'd	at Yorkville, Wm. B. Taylor.	
Composite culverts			
Stone box do			
Pipes, culverts Erieville reservoir		Van R. Richmond.	
		Squire Whipple.	353 22
Wood farm bridge abutmet's	72 x 12	Jno. T. Clark.	

Progress of the Canals in 1860.

Hon. Van. R. Richmond reported the "amount necessary to complete the enlargment, exclusive land damages, January 1st,

1861	$357,975
And the lateral canals, with engineering and contingencies	342,025
Total to complete	$700,000

The number of unfinished contracts on the 1st day of January, 1860, as stated in the last annual report from this Department, was 80. During the year 28 contracts have been completed and settled, and 24 new contracts have been entered into, leaving 76 contracts existing at the commencement of the present year.

The contracts settled the past year amount to $766,879.92. The existing contracts amount to $2,370,285.82, upon which the work remaining to be done is estimated at $294,633.89. The work remaining to be done, and not under contract, is estimated to cost $263,859."

Section 4, act chapter 213, Laws of 1860, authorized the Canal Commissioners to cut the bevels from the enlarged locks on the Erie, Oswego, and Cayuga and Seneca canals whenever it became necessary; also, to raise to 12 feet above 7 feet surface water, such of the bridges over said canals as are not now of that height.

Champlain Canal.

Section 2, act chap. 213, Laws of 1860, provides for "the improvement of the Champlain canal and Glens Falls feeder, so as to give for its entire length a depth of five feet of water, and a uniform width of thirty-five feet on the bottom, or as near these proportions as, in the opinion of the Canal Board, may be deemed judicious. This act, also, provides for rebuilding the residue of the locks on said canal (as soon as they may be required by the demands of navigation), and the stopping of all leaks in the Glens Falls feeder, for the sum of one hundred and seventy thousand dollars.

Statement showing the sums which have been appropriated and expended for rebuilding the locks on the Champlain Canal.

By act, chapter	329,	Laws of	1854	$25,000 00
do	330,	do	1854	25,000 00
do	528,	do	1855	25,000 00
do	148,	do	1856	25,000 00
do	157,	do	1856	60,000 00
do	365,	do	1857	121,391 08
do	149,	do	1859	60,115 00
1859, Sept. 30.	Appropriation overdrawn			69,136 86
				$410,642 94

The law making the appropriation of 1854, '55 and '56 distinctly specifies that it is "for the expense of enlarging the locks of the Champlain canal beyond the cost of reconstructing them of their present dimensions."

This well-defined description of the work intended to be embraced under the appropriations is left out in the subsequent acts of 1856, '57, '58 and '59.

The entire cost of all the works done under the acts of 1854, '55 and '56 has been charged to this canal, without making any deduction for the cost to "rebuild the locks of their present dimensions."

Statements showing the Tolls, Trade, and Tonnage of the Champlain Canal and Glens Falls Feeder, from 1850 *to* 1859 *inclusive.*

Years.	Tolls.	Value.	Tonnage.
1850	$133,969 43	$8,594,841 00	460,219
1851	119,333 77	5,910,213 00	513,793
1852	114,591 51	7,613,826 00	531,001
1853	120,998 05	10,604,522 00	608,354
1854	103,522 88	10,280,702 00	602,913
1855	106,524 67	10,558,378 00	537,108
1856	111,229 15	10,747,438 00	611,610
1857	104,889 99	14,176,061 00	547,236
1858	96,936 75	11,418,370 00	608,918
1859	106,361 91	17,523,193 00	820,673
	$1,118,358 11	$107,427,544 00	5,841,825

Statement of the Amounts Expended for Repairs of the Champlain Canal, from 1850 to 1859, inclusive.

Year.	By sup'ts, resid't engineers, and repair contractors.	By Canal Commissioners.	Total by sup'ts, resid't engin'rs, rep'r contractors and Canal Commissioners.
1850	$62,823 86	....	$62,823 86
1851	50,966 83	$13,539 15	64,505 98
1852	75,519 01	30,390 89	105,909 90
1853	78,963 36	5,321 78	84,285 14
1854	72,582 41	6,724 85	79,307 26
1855	90,383 21	12,175 28	102,558 49
1856	45,374 20	5,770 29	51,144 49
1857	72,640 31	200 00	72,840 31
1858	81,059 16	....	81,059 16
1859	64,875 76	9,947 25	74,823 01
	$695,188 11	$84,069 49	$779,257 60

Black River Canal.

The contracts for the following work were completed during the year 1860:

Woodhull lake reservoir, at a cost of $10,818; South branch reservoir $10,300; Delta feeder and bridges for same, $14,230.

There are now constructed on the branches of Black river three reservoirs—North and South branch, and Woodhull lake. These are useful to supply to the Black river in dry time the water diverted to the Boonville feeder for the navigation of this canal, and to furnish water for the Mohawk feeder at Rome.

Below are the capacities of the reservoirs and the number of acres flowed:

	Acres.		Capacities c. ft.
North branch reservoir	423	(filled twice)	619,868,800
South branch do	518		421,190,000
Woodhull do	1,236		780,943,680
Total	2,177		1,822,002,480

The total capacities of the three reservoirs will furnish 11,000 cubic feet of water per minute for 115 days.

By the Legislature of 1859 this amount of water was directed to be obtained in the construction of so many of the four reservoirs then contemplated as would furnish the 11,000 cubic feet.

Supply of water for the "Long" or "Summit" Level.

Reports upon Fish creek, and De Ruyter reservoir—Hon. Wm. I. Skinner advocating the adoption of the former and State Engineer Richmond the latter; which was subsequently adopted by the Canal Board. The following is Mr. Richmond's report, accompanying his annual report for 1859, on the same:

Supply of water.

"Provision is made for an adequate supply of water for purposes of navigation upon all the canals of the State now completed or under construction and enlargement, except the Rome level of the Erie canal.

Early last spring I submitted to the Canal Board for their adoption maps, plans and estimates for the construction of the De Ruyter reservoir (which is fully described in my former reports,) for the additional supply required for this level. Action was deferred to enable the Canal Commissioner of the Eastern division to have surveys and estimates made for a feeder from Fish creek. The results of these surveys, &c., were laid before the Canal Board in November last. The questions involved have been reported upon by two separate committees, of which the State Engineer and Surveyor was a member. A marked diversity of opinion existed between the members of the committee, and the undersigned deems it proper to give the following brief extracts from his report to the Board in support of the reasons that impelled him to officially recommend the construction of the De Ruyter reservoir.

The total amount of water furnished from present sources, can only be approximately estimated at this time, owing to the want of accurate gauges, in the dryest seasons, of some of the feeders. From the best information at my command, I estimate the present supply of water—with minimum flow of streams—between Lodi and Little Falls, at 24,600 cubic feet per minute.

The total amount required for a maximum of business upon the Erie, and a corresponding increase upon the connecting lateral canals, is estimated at 30,000 cubic feet per minute.

The deficiency between Lodi and Higgins, including the Oneida Lake canal, is estimated at 4,100 cubic feet per minute, and from Higgins to Little Falls, at 1,300 cubic feet per minute.

As these amounts are estimated for extremes, not only of demand, but of minimum supply, it is probably safe to assume

that 60 to 70 per cent. of these quantities would meet all the deficiency accruing in the next ten or fifteen years.

Two plans have been submitted for your consideration, to supply this deficiency.

The first plan contemplates constructing the De Ruyter reservoir, on the head waters of Limestone creek, and securing the supply through the present Limestone creek feeder into the canal six miles east of Lodi. It is estimated to furnish, for a period of 100 days, (assumed as the limit of drouth for which this supply is required,) 3,400 cubic feet per minute, at an estimated cost, including damages, of $120,000.

The second plan contemplates constructing Fish creek feeder, from near McConnellsville to the Erie canal near Fort Bull, a point about thirty-six miles east of Lodi. The feeder is estimated to cost, exclusive of damages to mill power upon Oneida and Oswego rivers, about $225,000, with a capacity of prism capable of furnishing 8,000 cubic feet per minute.

Neither of these plans can be so executed as to make the supply available until the spring of 1862.

The construction of Fish creek feeder would furnish a sufficient supply of water for all future wants, and would require a present expenditure of over $300,000, in addition to damages to mill power, &c. The construction of the De Ruyter reservoir would furnish an ample supply, in the judgment of the undersigned, for the next ten or fifteen years, and would require a present expenditure of $120,000.

If Fish creek feeder be adapted, the Lodi locks must be supplied, as now and formerly, from the Chittenango feeder, fourteen miles distant, passing the water against the prevailing winds, and the boats carrying the greatest tonnage. This can be done only by elevating the surface at Chittenango, and creating a strong current westward. A corresponding or greater elevation must be maintained at the mouth of Fish creek feeder, to supply the lockage from that point to Chittenango.

During the past three years, numerous observations have been taken in times of greatest lockages, (although never exceeding seventy per cent. of the maximum used as the basis of calculations for total required,) and the elevation of surface at Chittenango equaled five to seven inches above the same at Lodi. When the maximum business is attained, a larger amount of water

must be passed against a larger number of boats, &c., with a consequent increase of elevation and current.

It is reasonable to assume that the banks, aqueducts, weirs and bridges will eventually have to be raised between Manlius and Rome, to provide for this increased elevation of the surface of the water. The strong current consequent upon feeding Lodi locks from Chittenango, averaging from $\frac{1}{3}$ to $\frac{1}{2}$ mile per hour, would undoubtedly be a considerable detriment to navigation, and increase the cost of transit.

If the supply be obtained from the De Ruyter reservoir, it would enter the canal six miles east of Lodi, and have eight miles less distance to pass through the canal. It is obvious that the elevation and current would be greatly diminished.

The diversion of the waters of the Fish creek to the canal, would diminish, to a more or less extent, the machinery upon Oswego river, and decrease the tonnage or revenue of the canal.

The construction of De Ruyter reservoir would create and add machinery upon the Limestone, and to some extent add revenue to the canals.

The De Ruyter reservoir was substantially adopted many years ago, after a careful examination of the whole subject by Orville W. Childs, chief engineer. For the past few years it has been included in the estimates for completing the enlargement, and the present legislative appropriation for that object was based upon the estimate for this reservoir. In the opinion of the undersigned, it is doubtful policy, at this time, to double, or more nearly treble, the expenditure for this object.

Upon a careful consideration of the facts and circumstances connected with this question, I would respectfully recommend that the plan for constructing the De Ruyter reservoir, for furnishing an additional supply of water for the Rome level, be approved and adopted. I am confident in the belief that this plan will furnish all the additional water necessary for many years, and all that is expedient, or prudent economy to authorize at this time."

Report of Wm. I. Skinner, Canal Commissioner, upon Fish Creek Feeder.

To the Canal Board:

"The undersigned, one of the committee to whom was referred the subject of supplying the Rome, or long level of the Erie canal, with water, respectfully submits the following report:

The undersigned starts with what seems to be admitted on all hands, an insufficient supply of water on that level for the present purposes of navigation, and that this insufficiency will be increased with the increase of business and lockages.

I herewith submit a full and well considered analytical examination of the whole matter, prepared by S. H. Sweet, late resident engineer, and intend to make this the basis of my present remarks. The supplies and deficiencies, to and from various points between locks 47 and 39, are distinctly and briefly stated as well in relation to the present as the prospective trade on the canals.

The deficiency of water between lock 47 and Higginsville, or nine miles west of it, after the De Ruyter is brought in with an estimated supply of 3,891 cubic feet per minute, will be 1,707 cubic feet per minute. The distance to be supplied from Rome, west of Higginsville, will be nine miles, and the whole distance unsupplied, east of Higginsville, exclusive of Oneida lake, will be $18\frac{5}{6}$ miles, after the De Ruyter is brought in. If this deficiency has to be supplied from Rome, then it is evident, from the subsequent statements of Mr. Sweet, that the deficiencies to lock 39 will be so great, that even a five foot navigation cannot be maintained, in the dry season, between Rome and lock 39.

But can the estimated supply from the De Ruyter, of 3,891 cubic feet per minute, be relied upon?

If that amount is discharged from the reservoir, the residue, after deducting evaporation, lockage, and other wastage, will probably reach the canal in regular supply, if the State appropriates and pays the damages for the whole bed of the stream, and all the mills and other erections thereon, from the reservoir to the canal. If this be not done, the water discharged from the reservoir must pass through a colonade of mill dams from it to the canal. These dams will be closed at night, and when well filled to their full capacity, the State will probably be allowed to take the wastage until the mills are set running in the morning;

consequently the supply will be irregular, and then, as heretofore, the water at the west end of the level will run down by the discharges at lock 47; the boats on the west end of the level will be aground in the morning, and must remain aground until the level is raised by the discharges from the mill ponds.

If we have not yet had enough of this sort of partnership, between the State and private parties, in respect to waters needed for canal purposes, we shall probably get it after this reservoir is constructed, and an attempt to supply our needs for water from private mill dams. I refer to the remarks of Mr. Sweet on this subject, in note G of his statement.

In the estimate of the cost of construction of this reservoir, I do not understand the damages for the bed of the stream and the structures upon it are embraced.

The undersigned now passes to that part of the level from nine miles west of Higginsville east, and to lock 39 at Little Falls. The total deficiency on this part of the canal, including the Oneida Lake canal, is 9,369 cubic feet per minute, and without that canal 8,268. The distance from lock 39 to Higginsville, 48⅝ miles. The present supply taken in at Rome, and east of that place, is 15,030 cubic feet per minute. The required supply on the estimated trade, 18,801; deficiency, 3,771, showing that if the losses by evaporation, filtration and waste, between Rome and nine miles west of Higginsville, are made good by a feeder between these two points, all the deficiencies east of Rome will be supplied at that point, and by feeders east of it to lock 39.

A deficiency in the supply of water on this level, even for present purposes, seems to be admitted on all hands, and it is anticipated this deficiency will largely increase when we fill the canal to its enlarged capacity of seven feet by seventy, and we have seen that the De Ruyter reservoir cannot supply our wants, even on the western end of the level, from nine miles west of Higginsville to lock 47; leaving the intermediate distance to Rome unsupplied, or to be supplied from that place. The undersigned refers to the reports of division engineers Van Vleck and Taylor, read to this Board in December last, and also to the report of the State Engineer in November last, in reference to a resolution of this Board, of September 6, 1860.

Mr. Taylor estimates that a supply of 8,000 cubic feet per minute may be obtained from Fish creek, to be taken into the canal four miles west of Rome. This supply is obtained from a

living, running stream of water, and taken through a channel owned by the State, not liable to obstructions and diversions by mills and mill dams, nor subject to the claims of riparian owners.

But it is urged that heavy claims for damages will be interposed by citizens of Oswego, for the diversion of this water from a tributary of the Oswego river.

Let me inquire, one moment, into the extent of any claim of this sort; and the justice of it, if any should be established. All the leakage, soakage and drainage, from the canal west of Rome, is into lands bordering on Wood creek, a tributary of Oneida lake, and into lands bordering on that lake. None of it comes east of that point. All the discharges from the Erie canal through the Oneida Lake canal, are into the lake, being 1,101 cubic feet per minute. All the discharges at lock 47, are on to the Syracuse level, where they flow into tributaries of the Oswego river, and are equal, during the dry season, to 3,072 cubic feet per minute, supplied by the State from its numerous reservoirs. I may venture the remark, with much confidence, that not a drop of water from the Fish creek feeder will find its way east of Rome. Some of it may, but I do not think so. The waters of the contemplated feeder will crowd the natural and artificial flows into the canal west of it towards lock 47, and increase the discharges from that point into the Syracuse level. The loss to Oswego will be the difference in evaporation, &c., by the feeder water passing round into the Syracuse level by the contemplated route, and the more direct flow into the Oneida lake.

But, one moment to the equity of any such claim against the State, aside from any considerations resulting to the commerce and trade of Oswego, by a full supply of water on this level.

The drainage basin of the Oswego river is more than 75,000 square miles, and is equal to one-sixth of the area of the State.

Into this basin the State, by artificial channels, discharges from

Lake Erie and Chemung river, a volume of water equal to	11,887	cub. ft. per min.
From reservoirs during the dry season	5,816	do
From reservoirs, an increase by the increase of heads to certain reservoirs, as per report of State Engineer	3,072	do
Total	*20,775	do

* See detail calculation under note A for theoretical quantity.

By the application of these waters to the purposes sought, the commercial enterprise of Oswego will be fostered and promoted equal to that of any other place in the State, located upon our enlarged water communications. Has the State dealt harshly with that enterprise? Has she not given more than she proposes to take? And yet we should not take that even, if it can be avoided, nor if we are to respond in damages to an amount exceeding the public advantages to follow the appropriation. As the supply from the De Ruyter reservoir cannot be made available the next season, when the same may be needed, and as the supply from that source is confessedly inadequate to our wants, even when secured, the undersigned, in view of the great interests at stake, can cheerfully put himself on record in favor of the proposed Fish creek feeder. If any doubts shall be suggested in regard to the supply from this source, he will remark that the waters of Salmon river, as he is informed, can be brought into aid at small expense."

UTICA, *December 29th*, 1860.

HON. WM. I. SKINNER, *Canal Commissioner:*

Dear Sir—In answer to your several inquiries, made 21st inst., I beg leave to submit the following report:

NOTE A.

The quantity of water brought to the basin drained by the Oswego river, from Lake Erie and Chemung river .... =11,887 c. ft. per m.

NOTE B.

The quantity carried in the same direction from reservoirs during dry season ...... =*5,816 do

NOTE D.

The quantity required and used by the Oneida Lake canal .... = 1,101 do

NOTE G.

The supply from De Ruyter reservoir for 100 days .... = 3,891 do

NOTE C.

The present supply between lock No. 47 and Higginsville .... = 7,584 do

* See Note K for this quantity, as increased by State—3,072 cubic feet per minute.

NOTE H & E.

The quantity required for a trade of 300 lockages between said points	=13,179	c.ft. per m.

NOTE F & H.

The deficiency of above trade between said points	= 5,598	do

NOTE F.

The deficiency after adding De Ruyter to present supply for said trade and distance	= 1,707	do
The distance that water will be sent east of lock 47 with present supply	= $5\frac{1}{3}$	miles.
The distance the water will be sent east of lock 47, with De Ruyter added to present supply	= $24\frac{1}{2}$	do
The distance from lock 47 to Higginsville	= $33\frac{1}{2}$	do
The distance west of Higginsville to be supplied from Rome, after construction of De Ruyter	= 9	do

NOTE J & H.

The total deficiency between locks 47 and 39, including Oneida Lake canal	= 9,369	c. ft. per m.

NOTE I.

The present supply between Higginsville and lock No. 39 at Little Falls	=15,030	do

NOTE J.

The quantity required for a trade of 300 lockages per day for same	=18,801	do
The deficiency for above trade and distance	= 3,771	do

NOTE K.

The distance suplied west of lock 39, with present supply and above trade	= 30	miles.

NOTE I.

The distance from lock 39 to Higginsville	= $48\frac{5}{6}$	do

NOTE K.

The distance east of Higginsville (exclusive of Oneida Lake canal) unsupplied	= $18\frac{5}{6}$	miles.
The intermediate distance unsupplied, (including do.,) being $28\frac{1}{6}$ miles west, and $18\frac{5}{6}$ east, of Higginsville, (with present supply between Higginsville and lock 39)	= 47	do

Note E.

For the quantities discharged at different periods into Syracuse level, see detail calculation, Note E.

The following are calculations in detail of the foregoing results:

Note A.

The quantity of water brought to the basin drained by the Oswego river from Lake Erie and Chemung river.

1*st. From Lake Erie.*—Under a Senate resolution, dated January 26, 1850, the Canal Commissioners caused an examination and report to be made by Henry Tracy, Esq., upon the subject of a supply of water for the Erie canal from Buffalo to Montezuma, to be drawn from Lake Erie.

From the report of Mr. Tracy, the Commissioners fixed the size of the prism of the canal, from Tonawanda creek east, of capacity sufficient to deliver from Lake Erie at the following points, the following quantities, cubic feet per minute, viz:

To pass	Black Rock	35,020	cubic feet	per minute.
do	Tonawanda creek	31,240	do	do
do	Pendleton	31,000	do	do
do	Middleport	27,200	do	do
do	Albion	24,000	do	do
do	Brockport	21,000	do	do
do	Rochester	17,000	do	do
do	Clyde	6,100	do	do

Measurements were made under the direction of John D. Fay, division engineer, to find the actual discharge from Lake Erie. The measurements being made during the dry season of 1858, resulted as follows, viz:

Mean velocity $\frac{58}{100}$ miles per hour, between Black Rock and Tonawanda, discharge 31,370 cubic feet per minute at Tonawanda. Hence, the actual discharge being a trifle over the quantity contemplated, there must of necessity be delivered at Clyde at least 6,000 cubic feet per minute. The quantity passing at Clyde lock November, 1860, as measured by Mr. Schamerhorn =3,700 cubic feet per minute, the amount used.

2*d. From Chemung river.*—The water from this river is taken into the Chemung feeder at Gibson, and discharged into the summit level of the Chemung canal, at Horseheads, 16 miles in

length. This stream seldom, if ever, fails to supply the demand. There have been times when the full capacity of the feeder has not been realized, caused by neglect in keeping the bulkhead and structures in repair, and clearing the prism of a heavy growth of weeds.

The theoretical discharge of this feeder is=12,050 cubic feet per minute, but the actual discharge at canal is=10,870, and supplies the canal south from junction to Elmira, six miles, and north to Seneca lake, 17 miles. The quantity required and fed south is—(supply being) 10,870

24 lockages per day × 12,000 cubic feet each = cubic feet per minute	170	
Add 25 per cent. for flushing boats out of lock, = cubic feet per minute	42	
Evaporation on 6 miles, one-third inch from surface, = cubic feet per minute	25	
Leakage through lock gates, = cubic feet per minute	700	
Filtration on 6 miles, 63½ cubic feet per mile, = cubic feet per minute	381	
Waste at structures, 9 cubic feet per mile, = cubic feet per minute	54	
		1,372
Cubic feet per minute, started north =		9,498

The quantity lost on this in passing through the canal to Seneca lake:

Evaporation on 17 miles, one-third inch from surface, = cubic feet per minute	75	
* Filtration on 17 miles = cubic feet per minute	1,080	
* Waste on 17 miles = cubic feet per minute	156	
		1,311
Total cubic feet per minute discharged into Seneca lake from Chemung river		8,187
Total cubic feet per minute discharged into Seneca river from Lake Erie		3,700
Total c. ft. per min. discharged into Seneca lake and river		11,887

* 1,100 cubic feet per minute of this actually enters Seneca lake through the river adjoining the canal, which, together with the balance of the 6,000 cubic feet (after deducting quantity passed at Clyde lock,) thrown forward from Lake Erie, 2,300, increases the volume from 20,775 to 24,475 thrown into the Seneca river.

Note B.

The quantity of water discharged into basins drained by the Oswego river from reservoirs, during the dry season, in excess of the natural flow of the same.

If measurements are not made before the construction of a reservoir, the only method to obtain the "natural flow" from lake reservoirs, would be the drainage from valley or basin, minus the excess of evaporation over fall of rain on pond for a definite period; and the total supply, the artificial capacity added to the "natural flow." The following supplies are calculated for 120 *days*, July to October, inclusive, 10 *inches fall of rain*, 0.28 as the ratio of *drainage* to the total fall of rain, and 33 inches *evaporation* for this period, all adopted from the following facts and experiments, viz:

The average fall of *rain* in this State, from 1826 to 1856, for July, August, September, and October = 14.85 inches.

The ratio of *drainage* to the total fall of rain and snow for the year, was found to be for 1835, 1837, 1838, 0.44 per cent., from July to October, 0.28 per cent., determined from experiments by John B. Jarvis, Esq., on Madison and Eaton brook reservoirs.

Evaporation—(Dry season.)

From experiments made in St. Lawrence Co., = $\frac{33}{100}$ of an inch daily.

From experiments made by J. Trempter, Seneca lake, = $\frac{40}{100}$ of an inch daily.

From experiments made in Central Park, New York, = $\frac{50}{100}$ of an inch daily.

From experiments made in Erie and Chenango canals, $\frac{20}{100}$ to $\frac{33}{100}$ of an inch daily. And from other sources, found to be for the year 49 inches, in this State.

Taking the average of the five experiments, we have for daily evaporation, during dry season, $\frac{33}{100}$ of an inch.

1st. *From Skaneateles Lake reservoir.*—Area of pond = 8,320 acres; area drainage basin = 90,000; available head = 6 ft. The water is discharged into the Erie canal at Jordan, through the natural channel of the outlet, ten miles in length. Measurements were made by S. H. Sweet, of its flow during the dry season of 1859, and the entire season of navigation, and it was found to

deliver at the canal for 120 days, at the rate of; cubic feet per minute 7,520

Deduct nat. flow $= \left(\dfrac{(90{,}000 \times 43.560 \times \frac{10 \times 0.28}{12}) - (8320 \times 43.560 \times \frac{33-10}{12})}{120 \times 24 \times 60}\right) = 1{,}288$

Surplus of the canal, cubic ft. per min. 6,232

And the loss on this in passing seventeen miles through the canal to Montezuma, (where it is discharged into Seneca river,) is in proportion to the loss by filtration, waste and evaporation, on the whole amount passed in the canal, which was, in 1859, = 173 cubic ft. per min. per mile on 7,575 = 0.02281 loss on each cubic ft. passed per mile, which on above would be $= 6{,}232 \times 0.02281 \times 17 =$ 2,414

C. ft. per min., total discharged into Seneca river from Skaneateles lake 3,818

2d. *From Cazenovia Lake reservoir:*

Area of pond = 1778 acres; area drainage basin = 25,000; head $4\frac{1}{2}$ ft.

Capacity $= \dfrac{1778 \times 43.560 \times 4\frac{1}{2}}{120 \times 24 \times 60} =$ c. ft. per min. 2,017

+ natural flow $= \left(\dfrac{(25{,}000 \times 43.560 \times \frac{10 \times 0.28}{12}) - (1778 \times 43.560 \times \frac{33-10}{12})}{120 \times 24 \times 60}\right) = 614$

Total supply cubic ft. per min. 2,631

Deduct natural flow 614

Leaving a surplus at canal, cubic ft. per min. 2,017

and the loss on this in passing twenty-one miles, from Chittenango to Mud lock on the Oswego canal, (where it is discharged into Seneca river,) being the same per c. ft. as Jordan level $= 0.02281 \times 2{,}017 \times 21 =$ c. ft. per min. 966

Total surplus from Cazenovia lake, c. ft. per min. = 1,051

3d. *From Erieville reservoir:*

Area of pond = 340 acres; drainage basin = 8,000; head = $21\frac{1}{2}$ ft.

Capacity $= \dfrac{340 \times 43.560 \times 21\frac{1}{2}}{120 \times 24 \times 60} =$ c. ft. per min. 1,820

+ natural flow $= \left(\dfrac{(8000 \times 43.560 \times \frac{10 \times 0.28}{12}) - (340 \times 43.560 \times \frac{33-10}{12})}{120 \times 24 \times 60}\right) = 310$

Total supply, c. ft. per min. .... = 2,130

Deduct natural flow, c. ft. per min. .... = 310

Leaving surplus at canal, cubic feet per min. .... = 1,820

on which there is a loss in passing twenty-one miles through the canal from Chitteuango to Mud lock (where it enters Seneca river,) cubic ft. per min. = $0.02281 \times 21 \times 1820$ = 873

Total surplus from Erieville reservoir	=	947
do do Cazenovia lake reservoir	=	1,051
do do Skaneateles do	=	3,818
Total surplus from reservoirs, cubic ft. per min.		5,816

Note C.

The present supply of water to the canal, between Higginsville and Lodi, for July, August, September and October.

Under note B will be found the supply of Cazenovia lake and Erieville reservoirs, c. ft. per min. of both for 120 days	=	4,761
Oneida creek, c. ft. per min., as per measurement July, 1859	=	1,500
Limestone creek, c. ft. per min., as per measurement of July, 1859	=	500
Butternut creek, c. ft. per min., as per measurement of July, 1859	=	500
Other sources, c. ft, per min., Pool's brook, Cowassalon creek	=	320
Total supply 1859, c. ft. per min.	=	7,581
By repairing structures on feeders an increased supply may be obtained for 1861, as follows: Oneida creek, 300; Limestone, 250; Butternut, 125; Pool's brook, 50; Cowassalon creek, 150	=	875
Total	=	8,456

Note D.

The quantity of water required to supply the Oneida Lake Canal, or the amount used.

This canal is supplied from the Erie canal at Higginsville, which is 33½ miles from lock No. 47, and 24 miles from lock No. 46. It has seven locks, and an aggregate fall of 58 ft. to Oneida lake. The canal proper is 3¾ miles; creek navigation, 2¼. It became the property of the State under an act dated 11th May, 1840, which authorized the Canal Commissioners "to purchase the interest in the Oneida Lake canal and feeder, and the naviga-

tion of Fish creek." Stock to the amount of $50,000 was issued for the same, April 12, 1841.

A large quantity of water has been wasted on this canal the past ten years, caused by the leakage through old locks out of repair, and the quantity used will cover the amount required for contemplated new locks. It is believed that 20 lockages per day will be an ample estimate for the past and future trade of this canal, requiring for lockage water

canal, requiring for lockage water	166	c. ft.	per min.
Leakage through gates	650	do	do
Add 25 per ct. for flushing boats out of lock,	41	do	do
Evaporation on $3\frac{3}{4}$ miles, $\frac{1}{3}$ inch from surface,	11	do	do
Filtration on $3\frac{3}{4}$ miles, $62\frac{1}{2}$ cub. ft. per mile ..	233	do	do
Total c. ft. required and used on Oneida canal,	1,101		

Of which 820 cubic ft. per min. is discharged into Oneida lake.

Note E.

The quantity of water delivered at Syracuse from the west end of the "long level;" lockage, leakage and waste at No. 47, Lodi.

1st. *Leakage.*—Experiments were made in 1848 on locks 60 and 61, built in 1840, and leaked as follows:

No. 60, single, 10 feet lift	1,344	c. ft.	per min.
61, do 8 do	1,220	do	do
Others, do varying from 450 to	1,100	do	do
Lock No. 47, $10\frac{1}{2}$ feet lift: the gates are old and out of repair. It is deemed proper to allow for this lock, leakage	2,750	do	do

2d. *Lockage water, with total discharge.*—Cubic contents, 21,750 feet; 2 locks full to pass three boats; leakage per minute, 2,750; waste, $\frac{1}{4}$ of lockage water. Using the foregoing as a basis, the *total quantity* of water, *discharged* through the lock *upon* the *Syracuse level*, was, at different periods:

July to Oct., incl.,	1859,	daily avg.	101	lock'gs,	=4,021	c. ft.	per m.
Avg. for season,	1859,	do	93	do	=3,921	do	do
Largest month,	1859,	do	118	do	=4,172	do	do
do day,	1859,	do	177	do	=4,917	do	do
October 6th,	1860,	do	213	do	=5,430	do	do

It is believed safe for the future trade of the canal to provide water sufficient for 300 lockages, requiring 200 locks full of water

per day. This will make the quantity passed upon the Syracuse level, from west end of long level: lockage-

water $= \frac{200 \times 21.750}{24 \times 60}$	=3,020	c. ft.	per m.
Add $\frac{1}{4}$ for waste through culvert and flushing,	= 755	do	do
Leakage through lock gates, $10\frac{1}{2}$ feet lift	=2,750	do	do
Total cubic feet required per minute	=6,525		
Greatest quantity used in any one day, 1859,	=4,917	do	do
do do in July to Nov. 1859,	=4,021	do	do
do do October 6th, 1860	=5,430	do	do

Note F.

Deficiency between Higginsville and Lodi with present supply and trade, and the distance actually supplied east from lock No. 47.

Data:—

Under note C will be found the supply for 1859, c. ft. per min. 7,581
Under note C will be found the supply for 1861, c. ft. per min. 8,456
E quantity passed for periods of lockages, at No. 47.
H loss c. feet per min. per mile, 198.17
E quantity required at lock 47 for 300 lockages 6,525

The following tabular statement includes that portion between lock No. 47 and Higginsville, and not the supply of Oneida Lake canal:

Daily lockages at different periods.	Quantit's discharged into Syracuse level.	Present supply between Higginsville and lock No. 47.	Loss per mile per minute.	Formula.	Actual distance supplied east of lock No. 47.	Distance from latter point to Higginsville.	Deficiency between lock No. 47 and Higginsville.
	c. ft. per min.	c. ft. per min.	c. ft. per min.				c. ft. per min.
93, av. for season 1859....	3,921	7,581	198.17	$\frac{7,581-3,921}{198.17}$	18 2-3	14 5-6	2,940
101, July to Nov., 1859.....	4,021	7,581	198.17	$\frac{7,581-4,021}{198.17}$	18	15 1-2	3,072
118, largest month, 1859....	4,172	7,581	198.17	$\frac{7,581-4,172}{198.17}$	17 1-8	16 3-8	3,245
177, largest day, 1859......	4,917	7,581	198.17	$\frac{7,581-4,917}{198.17}$	13 1-3	20 1-6	3,996
213, Oct. 6, 1860...........	5,430	7,581	198.17	$\frac{7,581-5,430}{198.17}$	10 3-4	22 3-4	4,508
300, for future capacity....	6,525	7,581	198.17	$\frac{7,581-6,525}{198.17}$	5 1-3	28 1-6	5,598
With De Ruyter to present supply..................	6,525	11.472	198.17	$\frac{11.472-6,525}{198.17}$	24 1-2	9	1,707
As per Van Vleck's quantities, reported Dec. 5, 1859, with supply from De Ruyter reservoir added to his present supply..........	6,670	13.150	200.	$\frac{13.150-6,670}{200}$	32 4-10	1 1-10	220

Note G.

The supply that can be received from the proposed De Ruyter reservoir for 100 days.

1st. *Description.*—Is located in the extreme southwest corner of Madison county, town of De Ruyter, on the head waters of Limestone creek, and distant from the canal about 25 miles. There are a great many extensive mills upon the proposed outlet of this reservoir, which, with the present supply from the creek, are only able to operate about three-fourths the year—a very objectionable feature to its being made the outlet of a reservoir of such small capacity, as experience has demonstrated almost fatally on the Jordan level during the dryest period—withholding the water during the night by mill owners, for a strong head during the day.

2d. *Data.*—Area of pond = 626 acres; drainage basin, 12,000 acres; available head, $18\frac{1}{2}$ feet; fall of rain eight inches; ratio of drainage to fall of rain = 0.28; evaporation = twenty-four inches for one hundred days.

Capacity $= \frac{626 \times 43.560 \times 18\frac{1}{2}}{100 \times 24 \times 60}$ -------------- $=3,472$ c. ft. per m.

Add natural flow :=

$$\left(\frac{(12{,}000\times 43.560\times \frac{8\times 0.28}{12})-(626\times 43.560\times \frac{24-8}{12})}{100\times 24\times 60}\right)=420 \text{ c. ft. pr. m.}$$

Total supply for 100 days .... = 3,891 do do

Note H.

The loss by evaporation, filtration, and waste, on a mile of enlarged canal, per minute.

The quantities as given for the old size of canal were determined by experiments :

Evaporation, old canal. 3 c. ft. ; enl'gd canal, $\frac{1}{3}$ in. from surface = 14.25

Filtration, old canal, $63\frac{1}{2}$ cubic feet : enlarged canal—

$(\frac{4}{3}4\sqrt{4}+28\sqrt{4}) : (\frac{4}{3}7\sqrt{7}+52\frac{1}{2}\sqrt{7}) :: 1 : 2.45$ the old.... =155.57

Waste, old canal, 9 cubic feet : enlarged canal—

$(42+26)^{\frac{4}{2}} : (70+52\frac{1}{2})^{\frac{7}{2}} :: 1 : 3.15$ the old.............. = 28.35

Loss per mile, exclusive of lockages, cubic feet per min. =198.17

Lockage and total loss between lock 47 and Higginsville=

$33\frac{1}{2}\times 198.17+6.525$ .... =13.179

Total supply (see note C)....................................... = 7.581

Total deficiency between lock 47 and Higginsville, cubic feet per minute.............................. = 5.598

Note I.

Present supply between Higginsville and lock No. 39 at Little Falls, 49 *miles.*

From Mohawk river at Rome.—As per measurements made July, 1859, by Wm. B. Taylor, Esq............... 10,500 cub. ft. per min.

From Black River canal.—Lock ten feet lift, ten lockages per day = $\frac{10\times 15000}{24\times 60}$ .... — = 104 do do

Leakage through gates................ = 450 do do

Average feeding through $\frac{1}{2}$ valve of one opening .... = 740 do do

From Wood creek.—As per measurements made during dry season, 1854. = 125 do do

From Butts' creek.—As per measurements made during dry season, 1854. =1,400 do do

From Chenango canal.—Five feet lift first lock, eight lockages per day = $\frac{11\times8000}{40\times62}$ =	61	cub. ft.	per min.
Leakage through gates =	350	do	do
Average feeding through $\frac{1}{2}$ valve, one opening =	500	do	do
From Ilion creek.—As per measurements made August, 1856 =	800	do	do
Total supply =15,030	15,030	do	do

Henry Van Vleck's report, dated December 5, 1860, made to the State, gave the above supply at cubic feet per min. 14,950.

NOTE J.

Deficiency between Higginsville and lock No. 39 at Little Falls, for a trade of 300 lockages per day, and Oneida Lake canal for a trade of 20 lockages per day.

Quantity required for Oneida Lake canal, given under note D =	1,101	c. ft.	per min.
Utica weigh lock, 70 lockages per day and leakage =	1,375	do	do
Lockage water and leakage at No. 39, $10\frac{1}{2}$ feet lift (see note E) =	6,525	do	do
Loss on 49 miles by evaporation, filtration and waste (see note H) =	9,800	do	do
Total quantity used =	18,801	do	do
Total quantity supplied (see note I) =	15,030	do	do
Total deficiency =	3,771	do	do

NOTE K.

With the present supply between locks 47 and 39 and a trade of 300 lockages (requiring 200 locks full) per day, how far east of the former and west of the latter can the canal be supplied? the length of unsupplied portion, and amount required to supply the same.

Data:

Present supply between lock 47 and Higginsville (see note C) =	7,581	cub. ft.	per min.

Quantity required to pass lock 47 (see note E)	= 6,525	cub. ft.	per min.
Quantity required per mile (see note)	=198.17	do	do
Present supply between lock 39 and Higginsville (see note I)	=15,030	do	do
Quantity required to pass lock 39 (see note J)	= 6,525	do	do
Quantity required for Utica weigh lock (see note J)	= 1,375	do	do
Quantity required per mile (see note J)	= 200	do	do

Then the dist'ce supl'd east lock 47 $= \left(\frac{7,581-6,525}{198.17}\right) = 5\frac{1}{3}$ miles.

Dist'ce supl'd w'st lock 39 $= \left(\frac{15,030-6,525+1,375+1,101}{200}\right) = 30$ mls.

Distance unsupplied (from $18\frac{5}{6}$ miles east to $28\frac{1}{6}$ west of Higginsville = 47 miles.

Quantity required for unsupplied portion, including Oneida Lake canal, 9,369 cubic feet per minute.

NOTE K.

The drainage basin of the Oswego river exceeds 7,500 square miles, equal to one-sixth the area of this State, and embracing the important lakes of Cayuga, Seneca, Canandaigua, Crooked, Onondaga, Cazenovia, Oneida, Skaneateles, and five smaller, Owasco, Cross, Otter, and Fish lakes. Its extent, east and west, on the Erie canal, is from a few miles west of Rome to the west line of Wayne county, and extreme southern limits to within ten miles of Elmira.

Mr. Richmond reports the increased head to Cayuga lake and Skaneateles lake reservoirs by the State of two feet on each. This will make the surplus from reservoirs as follows:

	c. ft. per min.	
Skaneateles lake, proportion for two feet	2,507	
Deduct loss in passing 17 miles through canal, same per centage of loss as former	965	
		1,542
Cazenovia lake, proportion for two feet	1,120	
Deduct loss in passing 21 miles through canal	537	
		583
Erieville same		947
		3,072

Respectfully submitted.

S. H. SWEET.

Oneida Lake Canal.

Act, chapter 46, Laws of 1860, provides that when it shall become necessary to rebuild any of the locks on this canal, it shall be the duty of the Canal Commissioners to construct them of timber of the enlarged size. Under this law surveys and estimates were made, and the maps and plans submitted by the resident engineer on the 6th September last, locating all the locks, and reporting three of them as requiring immediate attention.

The estimated cost of rebuilding the seven locks of the enlarged size is	$80,120 00
Cost of rebuilding on old plan	54,761 00
Excess	$25,359 00

Tolls, Trade and Tonnage.

The whole number of tons carried one mile on the canals was 809,524,596, and on the railways 564,050,505. Compared with 1859 the mileage on the canals has increased 264,896,649, and that of the railroads 130,625,064. The increase on the canals, compared with 1859, in vegetable food was 885,503 tons, on the railroads 337,223. The tonnage on the railways and canals in merchandise has increased on both. The aggregate of this increase is 81,557 tons.

The following statement shows the shipment, by lake, of flour and grain from Chicago, in 1860, to United States ports on Lakes Erie and Ontario, and to Canadian ports on Lake Ontario:

Forwarded.	Flour.	Wheat.	Corn.	Oats.	Rye.	Barley.	Total bushels, red'ng flour to wheat.
	Bbls.	Bushels.	Bushels.	Bush.	Bush.	Bush.	
To Buffalo	116,322	6,865,417	8,554,978	464,339	96,495	46,471	16,609,310
To Oswego	500	2,238,657	1,764,794	41,036	......	10,887	4,057,874
To Ogdensburgh	31,575	273,953	681,104	13,078	......	......	1,126,010
To Dunkirk	......	......	100,789	......	......	......	100,789
To Cleveland	......	23,894	......	......	......	......	23,894
To other U. S. ports	5,861	7,188	64,340	79,912	......	2,970	183,715
To Collingwood, Canada	55,682	231,080	111,939	1,452	......	......	622,881
To Port Sarnia	1,380	368,877	248,126	......	......	......	623,903
To Kingston	......	780,174	185,422	......	......	......	965,596
To Port Colborne	2,225	721,562	1,294,466	5,487	18,191	......	2,050,831
To Prescott	......	......	40,763	......	......	......	40,763
To Montreal	5,196	207,316	......	......	......	......	233,296
To St. Catharines	......	99,358	......	......	......	......	99,358
To Toronto	......	......	16,322	......	......	......	16,322
Total	218,741	11,817,476	13,063,043	605,304	114,686	60,328	26,754,542

The above figures show that of the lake shipments from Chicago of more than twenty-six and three-quarter million bushels of grain, nearly twenty and three-quarter million bushels were sent to Buffalo and Oswego direct, Buffalo taking four to one over Oswego. Oswego, however, must have taken a very considerable portion of the Chicago shipments to Port Colborne, as well as shipments from other lake ports to the same point.

This statement shows the quantity of flour, and of wheat, corn, and other grains, first cleared at Buffalo, Oswego, and Phœnix, amounting to nearly forty-seven millions of bushels, which exceeds the shipments of any preceding year since the canals have been in operation by a very large amount:

	Flour.	Wheat.	Corn.	Oats.	Rye.	Barley.	Total bushels, red'ng flour to wheat.
	Bbls.	Bushels.	Bushels.	Bushels.	Bush.	Bushels.	
Buffalo	180,853	13,951,458	10,306,048	1,282,646	50,804	130,189	26,625,410
Oswego	421,032	6,786,606	4,538,341	401,514	165,687	1,201,101	15,198,409
Phœnix..........	412,093	1,193,249	1,171,625	168,013	29,212	472,372	5,094,936
Total	1,013,978	21,931,313	16,016,014	1,852,173	245,703	1,803,662	46,918,755

The following statements exhibit the comparative results for the periods above named. The tons carried each year, the tolls paid to the State, and the aggregate cost of transportation, tolls and freight, included in the average charges per ton:

	Tons carried.	Tolls.	Freight.	Aggregate of tolls and freight.	Av. pr. ton.
1847	2,869,810	$3,635,381	$4,818,152	$8,443,533	$2 94.56
1853	4,247,852	3,204,718	4,189,166	7,393,884	1 75.72
1860	4,650,214	3,009,597	5,039,853	8,049,450	1 73.12

In 1847, the toll paid to the State was 43.06 per cent. of the whole cost of transportation. In 1853, 43.34 per cent. and in 1860, 37.39 per cent.

	No. of tons moved one mile.	Toll and freight.	Av. pr. ton a mile.
In 1847.............	464,347,506	$8,443,533	$0 01.8
In 1853.............	626,025,883	7,393,884	0 01.2
In 1860.............	809,524,450	8,049,450	0 01.0

The canal prices on through freights, approximate nearer the rail charges than is shown by the above general averages.

The difference in favor of the canals in 1853 was $3.35 2-100 per ton, equal to $335.02 on 100 tons from Albany to Buffalo. In 1860 this difference was $2.27 19-100 per ton, equal to $227 19 on 100 tons, sent in the same direction. The merchandise tonnage of the road during the season of navigation, from October 1, 1859, to September 30, 1860, omitting five months of the fiscal year, was 120,526 tons. On this amount of tonnage the shippers paid $266,823.01 94-100 more freight than they would have done if sent by the canals.

Taking the average charge up and down, we see it is now very nearly one-fourth of what it was in 1840, and half of what it was in 1850. While the charge on 100 tons, up and down, has fallen from four to one, and from two to one, the tons delivered from the Erie canal—the business—has increased from nearly one to five, and one to two.

The cost of transportation seems to have gone down regularly with the increase of tonnage. The average cargo of the boats has doubled since 1850, and the lockages have decreased 6,000 since that time. With an addition of 905,202 tons to the tide water deliveries from the Erie canal in 1850, the average charges were 50 per cent. less.

Auditor Benton concludes his report on tolls, trade, &c., as follows:

"The conflict of political partizanship has not been the least evil encountered during the last thirty-five years of intense struggle which has been going on while our public works were moving to an enlargement and completion. The canals have forced themselves into public confidence, and we have the gratifying spectacle of seeing that the commercial tonnage borne upon their imperial waters in 1860, was a little more than 70 per cent. of the whole import and export tonnage of the United States.

"The year 1860 may be looked upon as the most remarkable period in this history of our canals. Increased tonnage, increased revenue, and decreased expenses, which in the aggregate, or singly, have no parallel since the waters of the great lakes and the Atlantic ocean were mingled in front of our own and the nation's commercial emporium."

Summary showing an annual excess of exportations from Canada to the United States, above those to all other countries together, from December 31, 1854, *to January* 1, 1861.

Years.	Total exports from Canada to the United States, Great Britain & all other countries.	Exports from Canada to the United States.
1855	$28,108,461	$20,002,290
1856	32,047,016	20,218,653
1857	27,006,624	14,762,641
1858	23,472,609	13,373,138
1859	23,102,378	13,922,314
1860	34,631,890	20,698,398
Total exports	$168,368,978	$97,955,504
Total exports to the United States	97,955,504	
Amount of exports from Canada to the United States, above those to all other countries together, for the last six years	$70,413,474	

Laws passed during the year.

Interest on canal drafts passed April 17, 1860, chap. 490. This law authorized the interest to be paid on all drafts which were entitled to interest under the law of 1859, chap. 149; interest to be paid until notified by the Auditor that he is prepared to pay the draft.

Sections 6, 7, 8, 9, 10, 11, 12, of the law creating the Contracting Board, repealed.

Repairs by Contract.

The following statement shows the names of the canals, the length in miles of each division of the Erie canal, and of the other canals, and the number of sections and locks on each, and the prices now paid under existing contracts.

CANALS.	Miles in length.	No. of Sections.	No. of locks.	Repair contracts 1st October, 1860.
Erie canal, Eastern division	136	5	52	$60,419
do Middle do	78	3	6	15,218
do Western do	155	5	20	41,167
Champlain canal and Glens Falls feeder	78	3	37	22,259
Oswego canal	38	--	--	-----
Oneida river improvement, Baldwinsville canal, and Seneca river tow-path	38	2	18	15,699
Cayuga and Seneca canal	23	1	11	3,574
Chemung canal and feeder	39	1	52	13,475
Crooked Lake canal	8	1	27	3,869
Chenango canal	97	3	114	22,000
Genesee Valley canal extension, and Dansville side cut	125	3	115	26,133
Oneida Lake canal and feeder	7	1	7	2,375
Black River canal	49	2	109	15,984
Black river improvement	42½	1	1	3,800
	911½	31	569	$245,972

The cost of repairing breaks on all the canals in 1858, was $144,394.20; in 1859, $31,003.95; and in 1860, $15,240.39.

Estimated Cost to complete the Canals, by Auditor Benton.

When the amended third section of the seventh article was projected in 1853, the estimated cost of completion, in addition to the $1,500,000 raised and applied under the canal revenue certificate law, was $9,000,000. The canal revenue certificate debt must be either excluded from or included in the cost of completion. The Auditor adopts the latter course, and thus fixes the estimated cost, in 1854, of enlarging and completing the canals, as determined by the amended third section, at $10,500,000, and states the amount as follows:

Borrowed under the amendment, to complete the public works and pay off the canal revenue certificates	$10,500,000 00
Applied from premiums on loans	1,482,192 67
Received from tax of 1857, and applied to construction	1,406,067 56

Received from tax of 1859, and applied to construction	$707,613 33
Floating debt loan	2,500,000 00
To be received on the taxes of 1860, and applied to complete	1,400,000 00
Received from temporary loan	200,000 00
Total amount of cost to enlarge and complete	$18,193,873 66
Sums raised and applied to pay interest:	
Borrowed prior to 1858, to pay interest	$1,500,000 00
Received from the tax of 1858, to pay interest	680,000 00
Received and to be received from the tax of 1860, to pay interest on the debt estimated	1,575,000 00
	$3,755,000 00

We see by the foregoing exhibit, that the cost to complete is double the estimate fixed in 1854.

Chenango Canal Extension and the Coal Trade.

State Engineer and Surveyor Richmond reported Jan. 10, 1860, to the Senate, the estimated cost of the Chenango canal extension from Binghamton to the State line, near Athens, $38\frac{48}{100}$ miles at $829,488.21. The survey was made under act chapter 88, Laws 1859.

Orville W. Childs was appointed, by Mr. Richmond, chief engineer, who submitted an able report of 50 pages, from which the following is taken, which presents a complete and thorough investigation of the coal trade as follows:

The following statement, compiled mainly from the tonnage reports on file in the Canal Department, shows the number of tons (2,000 pounds), the estimate value per ton, and the total value of the coal shipped at each office; and total tons, average value per ton, and total estimated value of the coal shipped at all of the offices on the State canals during each year from 1849 to 1858 inclusive.

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TABLE A.

	1854.			1855.			1856.			1857.			1858.		
	Tons shipped at	Price per ton.	Value at each office.	Tons shipped at	Price per ton.	Value at each office.	Tons shipped at	Price per ton.	Value at each office.	Tons shipped at	Price per ton.	Value at each office.	Tons shipped at	Price per ton.	Value at each office.
New York	9,225	......	$26,898	9,946	$5 00	$49,732	11,565	$5 00	$57,824	15,277	$5 00	$76,390	13,589	$5 00	$67,943
Albany	26,843	$6 00	161,061	23,409	6 00	140,453	31,204	5 00	156,019	27,843	5 00	139,217	17,221	5 00	86,107
West Troy	56,703	6 00	340,213	62,281	6 00	373,686	99,923	5 00	499,614	72,070	5 00	360,347	62,223	5 00	311,113
Schenectady	35	5 00	175	110	6 00	660	509	5 00	2,546	1,021	5 00	5,105	37	5 00	185
Fultonville	720	6 00	4,320	34	6 00	202	71	6 00	424	......	......	......	499	5 00	2,494
Little Falls	173	5 00	865	172	6 00	1,032	399	6 67	2,662	626	5 00	3,130	53	4 51	239
Utica	1,441	6 00	8,644	1,958	6 00	11,752	1,345	5 00	6,723	1,004	6 00	6,027	3,338	5 00	16,689
Syracuse	48	6 00	288	13	6 15	80	263	6 00	1,578	193	6 00	1,158	14,428	5 00	72,138
Jordan	......	......	......	23	6 00	138	......	......	......	......	......	......	8,780	4 00	35,121
Montezuma	42,950	5 00	214,748	52,682	6 00	316,094	......	......	......	......	......	......	56	4 00	223
Lyons	......	......	......	......	......	......	......	......	......	75	5 00	375	......	......	......
Palmyra	117	5 00	585	......	......	......	155	5 00	775	......	......	......	......	......	......
Rochester	5,076	6 00	30,456	2,473	5 00	12,362	2,259	5 00	11,294	1,983	5 00	9,917	2,533	5 00	12,663
Brockport	2	10 00	20	78	10 00	782	35	......	700	12	6 00	72	......	......	......
Albion	5	8 00	40	......	......	......	36	7 00	252	75	5 00	375	715	4 00	2,860
Medina	......	......	......	......	......	......	54	6 72	363	......	......	......	......	......	......
Lockport	......	......	......	2	6 00	12	......	......	......	......	......	......	......	......	......
Black Rock	......	......	......	70	6 00	420	......	......	......	......	......	......	......	......	......
Tonawanda	85	6 00	510	......	......	......	......	......	......	3	5 00	15	......	......	......
Buffalo	14,657	6 00	87,942	10,888	7 00	76,216	9,810	6 93	68,157	14,026	5 00	70,130	16,259	4 50	73,167
Waterford	9,089	6 00	54,536	16,007	6 00	96,044	8,258	6 00	49,547	37,777	4 00	151,108	51,706	5 00	258,530
Schuylerville	118	7 00	826	126	7 00	882	......	......	......	64	6 00	381	......	......	......
Whitehall	82	6 45	530	......	......	......	......	......	......	......	......	......	......	......	......
Fort Edward	......	......	......	......	......	......	......	......	......	......	......	......	379	5 00	1,894
Salina	......	......	......	......	......	......	1	4 00	4	......	......	......	......	......	......
Phœnix	......	......	......	......	......	......	731	5 00	3,655	759	5 00	3,795	688	5 00	3,443
Oswego	835	7 00	5,845	......	......	......	736	5 00	3,680	80	6 00	480	303	4 70	1,424

TABLE A.—Continued.

	1854.			1855.			1856.			1857.			1858.		
	Tons shipped at	Price per ton.	Value at each office.	Tons shipped at	Price per ton.	Value at each office.	Tons shipped at	Price per ton.	Value at each office.	Tons shipped at	Price per ton.	Value at each office.	Tons shipped at	Price per ton.	Value at each office.
Seneca Falls	9,792	$5 00	$48,960	11,735	$6 00	$70,409	....	......	....	....	......	....	....	......	....
Geneva	526	6 00	3,157	7	6 00	42	....	......	....	5,129	$6 00	$30,774	85	$3 40	$289
Ithaca	....	......	....	....	......	....	71,150	$4 00	$284,600	60,169	4 00	276,676	21,225	4 00	84,900
Horseheads	381	3 50	1,332	1,874	6 00	11,241	23,836	4 00	95,342	39,151	4 50	176,181	55,522	4 00	222,089
Corning	56,645	3 50	198,258	55,242	6 00	331,452	59,913	3 25	194,717	53,036	2 40	127,287	30,255	3 00	90,765
Penn Yan	....	......	....	24	5 00	120	....	......	....	407	5 00	2,034	465	5 00	2,323
Hamilton	....	......	....	....	......	....	....	......	....	....	......	....	3	4 33	13
Oxford	....	......	....	....	......	....	134	5 00	670	470	4 80	2,256	....	......	....
Binghamton	37,713	4 00	150,850	41,406	3 75	155,272	45,770	4 00	183,080	44,402	3 00	133,206	34,497	3 00	103,490
Scottsville	241	6 00	1,446	205	6 00	1,230	119	8 00	952	74	6 00	444	315	6 00	1,895
Mount Morris	....	......	....	5	10 00	50	....	......	....	....	......	....	....	......	....
Dansville	....	......	....	3	6 00	18	....	......	....	3	5 66	17	....	......	....
Baldwinsville	....	......	....	2	6 00	12	....	......	....	....	......	....	....	......	....
Higgins	....	......	....	....	......	....	67	6 00	404	....	......	....	2	5 00	10
Totals	273,502	......	$1,342,505	290,775	......	$1,650,393	368 343	......	$1,625,582	384,729	......	$1,576,897	335,176	......	$1,452,007

The Delaware, Lackawanna and Western Railroad and Coal company, now send coal from their mines at Scranton, on their road, to the N. Y. & Erie railroad at Great Bend, thence on the latter road to the Chenango canal and the Syracuse & Binghamton railroad, at Binghamton, and to Oswego, and over their railroad, the Cayuga & Susquehanna, to Ithaca, at the head of Cayuga lake.

Of this coal, the quantity shipped the past season on the Chenango canal, at Binghamton, as ascertained from the collector of canal tolls at that place, was 56,288 tons; and on the Syracuse & Binghamton railroad to Syracuse, about 60,000 tons; the quantity forwarded from Binghamton to Oswego, and across to Ithaca, the Cayuga lake, &c., though considerable, is not ascertained.

This being the principal if not the only anthracite coal now distributed along these several thoroughfares, the citizens are without the benefit of competition, and prices the past season ruled higher in that portion of the Susquehanna valley and along the southern and middle portion of the valley of the Chenango canal, than at several points on the Erie canal, where this coal comes in competition with others from the Wyoming valley, and other sources. In confirmation of this remark, a single instance may be specified. Coal, from the mines at Scranton, is sold at Binghamton at the rate of \$3.50 to \$3.75 per ton by the car load, and \$4 to \$4.25 per single ton. At Syracuse, by the larger quantity, for purposes of manufacturing salt, the price per ton has been \$3 for large lump, and \$3.10 for large egg, at the railroad companies' docks, delivered in canal boats for distribution among the several works; for domestic purposes, the prices at Binghamton and Syracuse appear to be about the same, notwithstanding it is delivered at the latter place at an expense of nearly \$1 per ton greater than at the former.

Of the coal from the mines at Scranton, shipped on the Chenango canal at Binghamton, the past season, a small quantity reached the Buffalo market, while of that from the Barclay mines shipped at Towanda, a portion reached Binghamton, via the North Branch canal, the Junction, Chemung, Cayuga and Seneca, Erie and Chenango canals.

As the Barclay mines lie nearer to the Chenango extension than any others, of bituminous coal, the quantity that would reach the eastern market through this very direct channel, would probably be larger from this than from any other bituminous

mines; this quantity would further depend on the character of the coal and the facilities of mining and delivering into canal boats at Towanda.

With reference to arriving at more reliable conclusions, or aiding the judgment in determining the prospective relative ability, based on the profits, of the several companies owning coal mines, to deliver coal to the docks at Albany, the following table is given, showing the name of the place at which coal is shipped by canal, the minimum selling prices established by the several companies respectively, at said places (excepting that at Hawley); the length of railway transit from the mines to the places of transfer to canal boats severally; the cost of railway transit; amount reserved for value of coal in mines, cost of mining, &c., and for profits; distances and cost of transport from the several places to, and the total cost per ton at Albany:

Names of places at which coal is shipped by canal.	Minimum selling prices at places of shipment (per ton.)	Length of railway transit from the several mines to the places of shipment (miles.)	Cost of railway transit (per ton.)	Leaving for value of coal in mines; cost of mining and for profits (per ton.)	Distance from the several places to Albany (miles.)	Cost of water transit in 1859, including tolls (per ton.)	Total cost per ton, in Albany.
Pittston	$1 10	....	......	$1 Estim'd	via exten. 341	$2 56	$3 66
Towanda........	1 75	16¼	17c	1 58	do do 266	1 87	3 62
Binghamton.....	2 55	62¼	62c	1 93	via Utica 207	1 45	4 60
Hawley.........	1 98	45	40c	1 58	via Rond't 160	1 90	3 88

The cost at Albany, as shown in the statement, is, of course, varied by the difference in cost of transport from the several points named, as well as by the value of coal fixed by the proprietors in the mines; which governs the minimum selling price at the several points of transfer, from railway cars to canal boats.

At Pittston, the selling price of prepared coal is $1.10 per ton; to this is added, in the table, for transportation to Athens, 81 cents, the price uniformly paid, as it is understood, the past season. From Athens to Albany the distance is reckoned, via. the Extension, Chenango and Erie canals, and in the statement the same price is allowed, or in proportion to the distance, as was paid the past season on the present route, via. Elmira, Montezuma, &c., which was a fraction over 7 mills per ton per mile. By this route the benefit of the navigation of a longer distance of enlarged canal would be realized; but an offset to this is found in the greater hazard and expense of passing the Seneca lake, as

compared to an equal distance of canal; and the higher toll charged on the Junction canal, which is 15 cents per ton for a distance of 18 miles, while, on an equal length of State canal, it would be one cent and 8 mills, making a difference in this respect against the economy of this route of a fraction over 13 cents per ton.

The distance, then, from Athens to Albany, being 250 miles, 7 mills per ton per mile would amount to $1.75, and including that from Pittston to Athens, would be $2.56, and adding selling price at Pittston, would give for the whole cost at Albany, $3.66 per ton. At Towanda, the selling price fixed by the company, as before stated, is $1.75; the transportation to Albany, 266 miles, at 7 mills, amounts to $1.87; these added give as the actual cost at Albany $3.62, and by deducting 17 cents, the cost of railway transit, leaves for coal in the mines, cost of mining, &c., and profits $1.58, or about 58 cents more than is charged for the same items at Pittston. So, at Binghamton, the minimum selling price being $2.55, which added to the cost of transportation on the canal at the same rate for 207 miles, gives $4 as the cost per ton at Albany; but deducting from this minimum price at Binghamton, 62 cents for the cost of railway transit, leaves for value of coal in the mines, mining, &c., and profits, $1.93, or 83 cents greater than at Pittston.

The Pennsylvania Railroad and Coal company's road extends from their mines at Pittston, 45 miles, to Hawley, on the Delaware and Hudson canal; it has an ascent and descent of about 2,250 feet, which is overcome by 22 planes, operated by stationary steam power, and by gravity. From Hawley the coal is taken on the Delaware and Hudson canal to the Hudson river, at Rondout, thence to market in either direction on that river. The toll charged for coal on that canal is understood to be variable, and is half of the excess of the market price at Rondout, above $2.50. This market price having averaged about $3.70, half the excess would amount to 60 cents per ton.

The price represented in the table as the minimum at Hawley, was not fixed by the Penn. R. R. & Coal Co., whose coal alone is transhipped at this point, but was fixed by allowing that company the same amount for the value of their coal in the mines; for mining, &c., and for profits, as is claimed by the Barclay R. R. & Coal Co., for the same items, and allowed them in the statement, and adding thereto 40 cents per ton, or a fraction less than 9 mills per ton per mile, a sum understood to be the exact cost of

transporting their coal 45 miles over their road; also 80 cents per ton, the uniform charge the past season for freight (exclusive of toll,) from Hawley to Rondout, 99 miles; for tolls on the Delaware and Hudson canal, 60 cents, the average of the past season, and for transportation on the Hudson river about 61 miles, to Albany, 50 cents, the uniform charge on this portion of the distance. Making, together, the cost at Albany, as stated in the table, $3.88 per ton. The quantity sent to market the past season by this company is not ascertained.

To further illustrate the table, or the relative ability of the several companies to sustain a competition in the Albany market, based upon profits, the value of coal at Albany is assumed at $4.50 per ton; this would leave to the several companies for the value of their coal in the mines, for the expense of mining, &c., and for profits, the sums shown in the last column of the following table:

COAL FROM	Assumed value in market p'r ton.	Cost in market per ton.	Profits on sales per ton.	Profits includ'g value in mines, cost of mining, &c., per ton.	Total profits including value in mines, cost of mining, &c., per ton.
Pittston	From $4 50	Deduct $3 66	84 cents.	Add $1 00	= $1 84
Towanda	" 4 50	" 3 62	88 "	" 1 58	= 2 46
Binghamton	" 4 50	" 4 00	50 "	" 1 93	= 2 43
Hawley	" 4 50	" 3 88	62 "	" 1 58	= 2 20

Thus showing if the expense of transportation on the several routes is correctly calculated, (and being based mainly on the actual prices paid the past season, it is not understood how they can be relatively or materially in error,) then the coal from Towanda, Pittston, or the Wyoming Valley, via. the Chenango extension, &c., can compete successfully with that from Pittston, and Scranton, via. Hawley and Binghamton.

In endeavoring to approximate, as nearly as may be, a correct estimate of these quantities, the following table has been prepared, mainly from official tonnage reports of the Canal Department, showing the tonnage, tolls, and estimated value of the coal and iron ore moved on the Chenango canal, the proportions of their tonnage tolls, &c., to the whole tonnage and tolls, &c.; also, in a more condensed form than is given in the former table, the total tonnage and value, and the total tolls received for coal on all the State canals from 1849 to 1858, together with other statistics in relation thereto, as indicated in the heading of the several columns.

TABLE B.—CHENANGO CANAL.

YEAR.	COAL.				TOLLS.			COAL, ORE, STONE, LIME, CLAY, LUMBER, TONNAGE, TOLLS, &C. &C.						
	Total coal shipped at Binghamton.	Total coal shipped at Binghamton, Oxford and Hamilton.	Value of coal at places of shipment (per ton.)	Estimated total value of coal at places of shipment.	Total tolls received for coal at Binghamton, Oxford & Hamil'n.	Total tolls received on all freight at Binghamton, Oxford & Hamilton.	Ratio of tolls received at the three offices on coal to the whole toll received at these offices.	Total coal left on the Chenango canal.	Total stone, lime and clay cleared at Binghamton, Oxford & Hamilton (tons.)	Total tolls received on stone, lime and clay, at Binghamton, Oxford and Hamilton.	Total tons iron ore arrived at Binghamton.	Total tolls received on iron ore that arrived at Binghamton.	Total tons of lumber shipped at Binghamton, Oxford and Hamilton.	Total tolls rec'd on lumber shipped at Binghamton, Oxford & Ha'n.
							Per cent.							
1849	....	....	....	....	....	$15,792	....	....	....	....	....	....	....	......
1850	6	6	....	....	....	16,392	....	524	....	....	....	....	22,920	$6,828
1851	432	432	$4 00	1,728	19	13,871	....	513	3,180	$408	....	....	18,833	5,492
1852	11,418	11,418	3 00	33,190	1,057	11,901	8.8	3,352	4,438	584	562	49	15,012	2,932
1853	33,259	33,259	3 50	116,407	3,019	15,271	19.7	18,120	3,597	579	14,119	1,242	15,239	3,546
1854	37,713	37,713	4 00	150,850	3,893	14,498	26.8	7,628	3,263	341	23,455	2,064	9,934	2,197
1855	41,406	41,406	3 75	155,272	4,251	15,875	26.8	13,455	5,390	381	23,470	2,065	9,365	2,256
1856	45,770	45,904	4 00	183,750	4,471	16,003	27.9	15,897	6,289	441	27,139	2,388	7,186	1,897
1857	44,402	44,872	3 01	135,462	4,495	15,429	29.1	11,633	3,074	249	29,002	2,552	6,667	1,665
1858	34,497	34,500	3 00	103,503	3,537	12,406	28½	2,203	3,183	214	21,274	1,872	7,044	1,779
1859	56,288	56,702	....	....	5,533	....	....	....	....	....	18,730	1,648	....	......

TABLE B.—CHENANGO CANAL—Continued.

YEAR.	Coal, Ore, Stone, Lime, Clay, Lumber, Tonnage, Tolls, &c., &c.							Coal from other States.	Coal at Hudson River, Tonnage, Value, &c.			
	Total tons of coal, ore, stone, lime and clay shipped at Binghamton, Oxford and Hamilton.	Total tolls received on coal, ore, lime, &c., shipped at Binghamton, Oxford and Hamilton.	Ratio of tonnage of coal, ore, stone, lime, &c., to the whole tonnage, at the three offices.	Ratio of toll received on coal, &c., at Binghamton, Oxford and Hamilton, to whole toll received at these offices.	Total tonnage of all freight on the Chenango canal, cleared at Binghamton, Oxford and Hamilton.	Total estimated value of all freight at the three offices.	Total tolls received at all the offices.	Total coal that arrived at Buffalo and Tonawanda from other States.	Total coal ascending Erie and Champlain canal from tide water (tons).	Total tons coal arrived at Hudson river from canals.	Estimated value per ton of coal arrived at Hudson river from canals.	Estimated total value of coal in Albany and Troy arriv'd at the Hudson river from the canals.
			per cent.	per cent.								
1849	....	....	....	....	36,557	$1,106,791	$25,721	1,495	37,531	12,585	$4 50	$56,633
1850	....	....	....	....	41,892	1,174,065	24,627	3,999	46,722	16,073	5 66	90,951
1851	....	....	....	....	40,307	1,078,403	22,022	4,230	67,204	13,055	4 50	58,753
1852	16,418	$1,690	36½	14.2	44,939	1,440,623	18,988	5,898	69,923	7,411	5 00	37,052
1853	50,975	4,840	66.6	31.7	76,538	1,999,803	22,439	10,413	95,333	15,137	5 00	75,685
1854	64,431	6,298	83½	43.4	77,142	1,556,623	21,494	15,548	92,801	42,902	8 98	385,415
1855	70,266	6,698	78.6	42.2	89,390	1,981,774	21,831	10,338	95,746	18,033	5 95	107,456
1856	79,332	7,300	75.2	45.6	105,502	2,284,391	21,818	9,730	142,692	27,079	5 00	135,397
1857	76,948	7,296	79½	47.3	96,722	2,395,088	20,277	14,094	116,211	14,080	5 00	70,400
1858	58,957	5,623	81.2	45.3	72,526	1,856,266	16,916	16,389	93,070	14,736	5 00	73,681
1859	....	....	....	....	....	....	....	....	....	....	....	....

TABLE B.—CHENANGO CANAL—Continued.

YEAR.	Coal left at New York from Erie and Champlain Canals, without breaking bulk at Troy and Albany.			Total movement of coal on all of the canals.	Estimated value per ton.	Total estimated value.	Total tolls received on coal on all the canals.	Ratio of tonnage of coal on the Chenango canal to the whole tonnage of coal on all of the canals.	Ratio of tolls received for coal on the Chenango canal to the whole toll received for coal on all of the canals.	Ratio of annual increase of the amount of coal shipped on all of the canals since 1849.
	Total tons.	Value per ton.	Estim'd total value.							
									per cent.	per ct.
1849	275	$4 50	$1,238	70,326	$4 41	$310,263	$13,824	....	....	....
1850	....	....	....	80,127	8 10	650,644	15,940	.0003	....	13.9
1851	1	5 00	7	112,277	4 40	493,745	15,818	.0038	0.1	40.1
1852	16	5 00	78	145,296	4 76	692,581	19,054	.0786	5½	29½
1853	482	5 00	2,408	225,507	4 85	1,092,836	26,158	.1474	11½	55.2
1854	3,764	4 00	15,085	273,502	4 90	1,342,505	40,389	.1377	9.6	21.2
1855	739	5 00	3,694	290,775	5 67	1,650,393	40,113	.1424	10.6	6.3
1856	473	5 00	2,366	368,343	4 41	1,625,582	42,079	.1246	10.6	26.6
1857	252	5 00	1,260	384,729	4 10	1,576,897	43,750	.1166	10.2	4.4
1858	1,261	5 00	6,307	335,176	4 33	1,452,007	32,783	.1029	10.8	....
1859	....	....	....	....	....	....	....	....	....	....

From the foregoing statement, it appears that there was an annual increase in the quantity of coal shipped at Binghamton, (all by railroad,) from the Scranton mines, up to 1857, and that in 1858 it fell off to nearly the amount of 1853; and that in 1859 the quantity very largely exceeded that of any former year. Also, that previous to 1857, about one-third of the coal shipped at Binghamton was left on the Chenango canal, and of that shipped in 1857 and 1858, only about one-sixth was left; and that the proportion of tolls on coal received at Binghamton, Oxford, and Hamilton, from 1854 to 1858, averages about 28 per cent. of the whole tolls received at these offices.

The iron ore was from the Clinton beds, and, as understood, was all taken to the Scranton iron works, in Pennsylvania. The annual average quantity that arrived at Binghamton during the six years preceding 1859 was 23,076 tons, and it fell off in 1859 to 18,730 tons, while the coal shipped at Binghamton, Oxford, and Hamilton, in 1859, was greater than the average of the preceding six years, 17,093 tons, and greater than in 1858 by 22,202, an increase of over 64 per cent.

As deduced from table B, the average ratio of the tonnage of coal, limestone, &c., and ore shipped at Binghamton, Oxford, and Hamilton, is $71\frac{6}{10}$ per cent. of the whole tonnage reported at these offices, and the average ratio of tolls received on the coal, limestone and ore shipped at the three offices above named for the five years preceding 1859, is $44\frac{7}{10}$ per cent of the whole toll received at the same offices.

The proportion of the tonnage of coal on the Chenango canal, to the tonnage of coal on all of the canals, appears to have been about 14 per cent. in 1854 and 1855, and that it gradually diminished to about 10 per cent. in 1858, while the proportion of tolls received for coal on the same canal to the tolls received for coal on all the canals, has fallen from $11\frac{1}{2}$ per cent., in 1853, to $9\frac{6}{10}$ per cent. in 1854, when it increased gradually to $10\frac{8}{10}$ per cent. in 1858; this, while it shows a relative diminution in the quantity from the Chenango canal, at the same time shows an increase in the distance moved, and a market more widely extended, as compared with that of the coal of the other canals, or that from other sources.

Some general ideas of the probable future increase in consumption of coal, and the prospective quantity that would be

sent forward from the Barclay and Wyoming Valley mines, may be obtained by observing the increase in the quanty sent forward from other mines during the ten years from 1849 to 1858, inclusive, as shown in the following extracts from tables reported in vol. 15, No. 33, of the American Railroad Journal; also the increase of the three years from 1854 to 1856, inclusive, over the three previous years, and the increase of 1858 over 1857, and the per centage of increase.

TABLE C.

Years.	Quantity deposited at Philadelphia from the Schuylkill region by the Schuylkill canal and the Reading railroad.			Quantity of coal brought from the Lehigh region, and from the Wyoming valley to the Delaware river at Easton, by the Lehigh Navigation and the Lehigh Valley railroad.			Quantity of coal received at New York from the Delaware by the Morris canal, and from the Lackawanna valley by the Delaware, Lackawanna and Western railroad.		Amount of coal received at Rondout from Pittston, by the Pennsylvania Co.'s railroad, and from Carbondale and Upper Lackawana valley, by the Delaware and Hudson Comp'ny's railroad and canal.	
	By canal.	By railroad.	Total.	From the Lehigh region.		From Wyoming valley by railroad and canal.	Morris canal.	Delaware, Lackawana and Western railroad.	Pennsylvania Company's railroad.	Delaware and Hudson Co.'s railroad and canal.
				By canal.	By railroad.					
	Tons.	Tons.	Tons.	Tons.	Tons.	Tons.	Tons.	Tons.	Tons.	Tons.
1840	....	....	....	225,318	....	....	....	....	....	....
1841	....	....	....	Not reported.	....	....	....	....	....	....
1842	491,602	49,902	....	do	....	....	....	....	....	....
1849	Not rep'td sep.	Not rep'td sep.	1,605,126	do	....	19,590	114,017	....	....	454,240
1850	do	do	1,712,607	690,456	....	32,156	104,323	....	fi't op'd 111,014	441,403
1851	do	do	2,184,240	964,224	....	25,072	148,262	....	316,017	479,078
1852	800,038	1,650,912	2,450,950	1,072,136	....	41,890	190,277	....	426,164	497,105
1853	888,695	1,582,248	2,470,943	1,054,309	....	26,235	235,805	....	512,659	494,327
1854	907,354	1,987,854	2,895,208	1,207,186	....	39,202	284,606	....	496,648	440,944
1855	1,105,263	2,213,292	3,318,555	1,275,950	First op'd 9,063	50,209	299,682	First open'd 217	504,803	565,460
1856	1,169,453	2,088,903	3,258,356	1,186,230	165,740	44,270	311,929	121,113	612,500	499,650
1857	1,275,988	1,709,692	2,985,680	900,314	418,236	37,967	298,011	295,953	543,873	480,677
1858	1,323,804	1,542,646	2,866,450	908,800	471,930	69,644	345,725	538,247	630,056	347,873
	Opened 1822, (1,480 tons.)	Opened 1841.	....	Opened 1820, 365 tons.)	Opened 1855.	First repo'td 1846, (5,886)	First reported 1849.	Opened 1855.	Opened 1850.	Opened 1829. (7,000 tons.)
Total tons in 1851, '52, '53........			7,106,133	3,090,669	....	93,197	574,344	....	1,254,840	1,470,510
do 1854, '55, '56........			9,472,119	3,668,466	174,803	133,711	896,217	121,330	1,613,951	1,506,054
Increase of the three latter over the three former years			2,365,986	577,797	174,803	40,514	321,873	121,330	359,111	35,544
Per cent of increase of the three latter over the three former years..			33 3-10	18 6-10	....	43 5-10	56	....	28 6-10	2 4-10
Difference in tons forwarded in 1857 and 1858........................			Decrease 119,230	Increase 8,486	Increase 53,694	Increase 31,677	Increase 47,714	Increase 242,294	Increase 86,183	Decrease 132,804
Per cent of difference of 1857 and '58			3 9-10	1	12 8-10	83 4-10	16	81 8-10	15 8-10	27 6-10

The average per cent. of increase of the whole movement in the years 1854, '55 and '56, over the three previous years, was 29 4-10.

Recapitulating the items and estimated amount that would form part of the probable increase of business on the canals of this State, from such extension, and calculating the tolls at the rates at present established for the several distances, to which each item would be entitled, gives the following results:

Coal.—100,000 tons, increased as above, $37\frac{8}{10}$ p. ct.=137,800 tons.

Toll from State line to Utica, $135\frac{1}{2}$ miles, at one mill per ton per mile	$18,671 90
Toll on 500,000 tons from Utica to the Hudson river, 105 miles, at one mill per ton per mile	5,250 00
Iron ore.—Toll on 55,000 tons from Clinton to State line, $126\frac{1}{2}$ miles, at one mill per ton per mile	6,957 50
Lime, &c,—Toll on 3,677 tons from Oriskany Falls to State line, $116\frac{1}{2}$ miles, at two mills per ton per mile	856 74
Boards and scantling.—Toll on 4,500,000 feet, board measure, from State line to Albany, 245 miles, at five mills per M. feet per mile	5,512 50
	$37,248 64

The rapidly increasing traffic in coal, and the prospective increase in its future demand, together with the long distances that this article and that of lumber would, after passing the Extension canal, be moved on the other State canals, also the long distances that iron ore and limestone would be so moved, not only justifies the foregoing calculations and the conclusions arrived at in regard to the amount of business that would be done upon it, and the toll it would produce, but should attach to it a degree of importance that could only be appreciated by a knowledge of its location, the relation it would sustain to other canals as a connecting link, and of the large amount of coal it would be the medium of annually introducing for consumption in this State.

Respectfully submitted.

O. W. CHILDS, *Civil Engineer.*

Progress of the Canals in 1861.

Hon. Van R. Richmond reported the cost to complete the enlargement of the Erie canal, exclusive land damages, after Sept. 30,

1861	$188,255 71
Lateral canals, including $50,000 for Champlain canal locks	133,306 52
Engineering and contingencies	68,437 77
Total	$390,000 00

Mr. Richmond estimated that $75,000, exclusive of the above, would be required to bottom out the Erie canal at various points.

"The amount work done, and the cost of engineering, for the last seven years, and the percentage on the whole amount of work done in each year, is shown in the table below:

Year.	Work done.	Cost of engineering.	Per centage on work done.
1854	$873,713 84	$144,136 43	$16.5
1855	3,524,898 03	211,982 73	6
1856	3,864,014 95	245,618 48	6.4
1857	2,862,923 07	182,991 05	6.4
1858	1,668,606 55	130,471 26	7.8
1859	1,022,689 19	89,728 85	8.8
1860	689,127 97	80,657 86	11.7
1861, up tp Sept.30	717,330 52	54,526 43	7.6

"The contracts settled from January 1 to September 30, 1861, amount to $191,289.03. The existing contracts amount to $2,463,215.60, upon which the work remaining to be done is estimated at $260,048.23. The work remaining to be done, and not under contract, is estimated to cost $60,308."

De Ruyter Reservoir.

This work was put under contract the 29th of March last, to be completed by the first of November next. Although the work will not be completed, it will be made available for at least forty feet depth of water that can be drawn another season.

The culvert and well masonry is completed, and the pipes and stop-cocks laid. The work of filling in the embankment above will go forward rapidly. The work is estimated to cost in round numbers, at contract prices, $80,000, and unless some unforeseen difficulties arise is believed to be ample.

The supply that can be received from the De Ruyter reservoir for one hundred days:

The reservoir is located in the extreme southwest corner of Madison county, town of De Ruyter, on the head waters of Limestone creek, and distant from the canal about 25 miles.

Area of pond=626 acres; drainage basin, 12,000 acres; available head, 18½ feet; fall of rain, eight inches; ratio of drainage to fall of rain=0.28; evaporation=24 inches for 100 days.

$$\text{Capacity}=\frac{626\times 43.560\times 18\tfrac{1}{2}}{100\times 24\times 60}\text{ - - - - - - - - - - - }=3{,}472\text{ c. ft. pr. m.}$$

Add natural flow :=

$$\left(\frac{(12{,}000\times 43{,}560\times \frac{8\times 0.28}{12})-(626\times 43.560\times \frac{24-8}{12})}{100\times 24\times 60}\right)=420\text{ c. ft. pr. m.}$$

Total supply for 100 days .... =3,891

Tolls, Trade and Tonnage.

The following statement shows the number of tons of each class of property carried on the canals during the season of navigation, in the year 1861; and on all the railroads in the State from the first of October, 1860, to the 30th September, 1861. Comparing these two years, and we find the carrying trade on the canals has fallen off 142,579 tons, while that on the railroads has increased 718,636 tons. The aggregate of the increase in tonnage on the canals and railways in 1861 over 1860, is 576,057 tons.

Description of articles.	Tons of each class carried on the canals.	Tons of each class carried on all the railroads.	Total tons of each class carried on the canals and railroads.
Products of the forest	1,052,392	540,079	1,592,471
Products of animals	19,282	1,067,070	1,086,352
Vegetable food	2,122,237	1,220,332	3,342,569
Other agricult'l products	2,854	211,209	214,063
Manufactures	280,256	568,691	848,947
Merchandise	135,096	719,017	854,113
Other articles	895,518	1,134,011	2,029,529
Total tons carried	4,507,635	5,460,409	9,968,044

Mileage on the canals, 863,623,507.
Mileage on the railways, 660,556,875.

The mileage, or number of tons carried one mile, is stated at the foot of the table. Compared with 1860, the mileage on the

canals has increased 54,099,011, and on the railroads 96,506,370. The tonnage of merchandise on the railways and canals, has decreased on both.

The following statement shows the number of tons of each class of property carried in 1861, the tolls paid on each class on the rates of that year, and what the tolls would have been under the rates of 1851 and 1857.

Classes of property.	Tons transported in 1861.	Tolls received in 1861, under the rates of that year.	What the tolls would have been on same tonnage on the rates of 1851.	What the tolls would have been on same tonnage on the rates of 1857.
Boats and passengers of 1861.	....	$207,924	$207,924	$207,924
THE FOREST.				
Furs and peltry	155	81	81	81
Product of wood	1,052,237	398,566	339,351	375,333
AGRICULTURE.				
Product of animals	19,282	14,132	22,943	17,757
Vegetable food	2,122,237	2,856,846	2,957,263	2,941,839
All other agricul. products	2,854	1,220	2,584	2,473
Manufactures	280,256	95,722	117,032	103,184
Merchandise	135,096	107,958	375,602	209,919
Other articles	895,518	226,336	331,071	280,546
	4,507,635	$3,908,785	$4,353,851	$4,139,056

The river freight to New York, charged by canal lines on wheat and corn, during the season of 1861, averaged per month as follows:

	Wheat per bush.	Corn per bush.
May	03	02¾
June	02½	02¼
July	02½	02
August	02	02
September	02	02
October	04	03½
November	04½	04½

STATEMENT,

Showing the average rate of Lake freight on wheat and corn between Chicago, Buffalo and Oswego, also the average rate of Canal freight on the same articles between Buffalo, Oswego and New York, for each month during the season of navigation 1861.

Period.	From Chicago to Buffalo.		From Buffalo to New York.		From Chicago to Oswego.		From Oswego to New York.	
	Wheat. 60 lbs.	Corn. 56 lbs.	Wheat. 60 lbs.	Corn. 56 lbs.	Wheat. 60 lbs.	Corn. 56 lbs.	Wheat. 60 lbs.	Corn. 56 lbs.
	c. m. f.	c. m. f.	c. m. f.	c. m. f.	c. m. f.	c. m. f.	c. m. f.	c. m. f.
April	13 6 9	12 8 1	....	....	17 3 3	15 6 6	....	....
May	07 2 5	06 3 7	13 8 7	12 8 1	11 5 6	10 5 6	09 2 8	08 2 2
June	06 8 8	06 3 1	11 3 8	10 3 8	10 0 0	09 3 8	08 0 0	07 0 0
July	05 7 5	05 2 5	11 5 0	10 5 6	08 5 6	07 9 3	08 0 0	07 0 9
August	10 0 0	08 8 1	11 8 1	10 8 1	13 8 8	12 6 3	08 2 5	07 2 5
September	14 0 0	12 9 3	15 7 5	14 5 0	18 9 3	17 8 1	10 7 5	09 7 5
October	18 6 3	17 2 5	20 3 1	18 3 8	24 4 3	22 5 0	13 9 3	12 9 3
November	16 0 8	14 7 5	25 6 6	23 5 8	20 6 6	19 2 5	19 5 8	18 5 0
Av. for the season.	11 5 3	10 5 6	15 7 5	14 4 3	15 6 7	14 4 6	11 1 1	10 1 0

The above rates include canal tolls, as follows:

On wheat per bushel, from Buffalo to Troy............ 05. 1.7
On corn per bushel, from Buffalo to Troy.............. 04. 8.3
On wheat per bushel, from Oswego to Troy............ 0.2 9.5
On corn per bushel, from Oswego to Troy.............. 02. 7.5
Highest rate lake freight from Chicago to Buffalo... 26c. wheat.
do do do Oswego... 30½c. do
do canal freight from Buffalo to New York 30c. do
do do Oswego to New York 22c. do

The statement showing tons of total movement for six years, the freight and tolls paid, and the average cost per ton a mile on railways and canals. The canal averages do not cover the forwarder's charge for transportation.

1856.	Tons moved one mile.	Freight and tolls.	Average per ton one mile.
New York Central railroad	145,733,678	$4,328,041	2.97 cents.
New York and Erie railroad	183,458,046	4,545,782	2.48
Canals	592,009,603	2,748,212	4.22 mills.
Totals	921,201,327	$11,622,035	1.26 cents.
1857.			
New York Central railroad	145,873,791	$4,559,276	3.13 cents.
New York and Erie railroad	167,100,850	4,097,610	2.45
Canals	484,750,864	2,045,641	4.21 mills.
Totals	797,725,505	$10,702,527	1.34 cents.

1858.	Tons moved one mile.	Freight and tolls.	Average per ton one mile.
New York Central railroad	142,691,178	$3,700,270 44	2.59 cents.
New York and Erie railroad	165,895,635	3,843,310 77	2.32
Canals	564,842,095	2,110,754 00	3.71 mills.
Totals	873,428,908	$9,654,335 21	1.10 cents.
1859.			
New York Central railroad	157,136,000	$3,337,148	2.13 cents.
New York and Erie railroad	147,127,039	3,195,869	2.17
Canals	544,309,072	1,723,945	3.16 mills.
Totals	848,572,111	$8,256,962	0.97 cents.
1860.			
New York Central railroad	199,231,392	$4,095,934	2.06 cents.
New York and Erie railroad	214,084,395	3,884,343	1.84
Canals	809,524,596	3,009,597	3.72 mills.
Totals	1,222,840,383	$10,989,874	0.90 cents.
1861.			
New York Central railroad	237,392,974	$4,644,449	1.96 cents.
New York and Erie railroad	251,350,127	4,351,464	1.73
Canals	863,623,507	3,908,785	4.53 mills.
Totals	1,352,366,608	$12,924,698	0.94 cents.

The above statement shows there was a large increase in traffic during the year 1861 over any other year embraced in the series. This increase is 130,526,225 tons moved one mile, and an increase of $1,934,824 in freight and tolls over 1860, and of $1,302,663 over 1856.

It will be noticed that the average rates per ton on the canal went down on the reduction of tolls in 1858–9, and that in 1860 and 1861, the canal averages went up after the Canal Board in those years increased the rates of toll.

It will also be noticed that, in 1861, the averages on the New York Central railroad have run down from 3.13 cents, in 1857, to 1.96 cents a ton a mile—a reduction of 1.17 cents a ton a mile. That the averages on the New York and Erie have run down from 2.48 cents a ton per mile in 1856 to 1.73 cents in 1861,—a reduction of three-fourths of a cent or 7.5 mills, which is equal to a loss of $1,885,125.19 on freight. This road received in 1861 $194,336 less in freight than in 1856, on an increased carriage of 67,892,081 tons carried one mile. It will be found on examining the tables that the New York and Erie railroad carried, in 1861, 310,203 tons more than in 1856, of through and way freight, but the aggregate earnings were $194,336 less.

The figures below, compiled from the reports of the Central R. R. company, present the traffic of the road in January and

August, 1861; the number of tons carried one mile in each month, the freight received, and the average per ton per mile:

	Tons moved one mile.	Freight.	Average per ton per mile.
New York Central RR., January	16,017,336	337,391	2.11 cts.
do do August	18,229,903	324,687	1.78
Total	34,247,239	662,078	1.93

Percent of tonnage for January 46.77
Percent of tonnage for August 53.23
Percent of freight for January 50.96
Percent of freight for August 49.04

ENLARGEMENT OF THE CHAMPLAIN CANAL AND ERIE CANAL LOCKS FOR THE PASSAGE OF GUN BOATS TO THE LAKES.

The following are extracts taken from a report submitted by Wm. B. Taylor, State Engineer and Surveyor, in answer to an Assembly resolution, March 5th, 1862.

"The following is an estimate of the cost of enlarging one tier of locks the whole length of the Erie and Oswego canals, 25 feet wide and 165 feet between quoins, admitting of the passage of a boat 24 feet wide by 150 feet long:

Erie Canal—Eastern division.

Enlarging 45 locks	$1,485,550 00	
Constructing one lock (No. 2)	53,350 00	
Enlarging one of three weigh locks, scales, &c	50,000 00	
		$1,588,900 00

Middle division.

Enlarging six locks	$183,000 00	
do one weigh lock, scales, &c.	42,000 00	
		225,000 00

Western division.

Enlarging one lock	$30,000 00	
do two guard locks	93,000 00	
do one weigh lock	48,000 00	
do five locks at Lockport	198,000 00	
Constructing 13 locks	608,000 00	
Valve gates and fixtures	25,000 00	
		1,002,000 00

Total for enlarging locks, Erie canal $2,815,900 00

Oswego Canal.

Enlarging 18 locks	$607,500 00	
Valves and fixtures	18,000 00	
		$625,500 00
Total for enlarging locks, &c., on Erie and Oswego canals		$3,441.400 00

Estimaated cost of making the Champlain a ship canal.

The following is an estlmate of the cost of enlarging the locks of the Champlain canal to 25 feet in width, admitting a boat 150 feet long. Also an estimate of the cost to enlarge the prism of said canal to the same size as the enlarged Erie canal, together with all mechanical structures, as submitted by Daniel C. Jenne, division engineer in charge:

Enlarging locks		$815,000 00
do 66 miles of canal	$1,650,000 00	
do structures on same	507,900 00	
		2,157,900 00
		$2,972,900 00
Add 10 per cent. for contingencies and engineering		297,290 00
Total, exclusive of land damages		$3,270,190 00
Add for land damages		500,000 00
Total cost of ship canal		$3,770,190 00

The following communication, received from Mr. Delano, naval constructor at the Brooklyn Navy Yard, (in answer to the inquiry as to the smallest size of gun boats that, in his opinion, should be used upon the lakes,) served to aid in fixing the size and capacity for enlargement:

"NAVY YARD, NEW YORK, *March* 13, 1862.

Hon. W. B. TAYLOR,

State Engineer and Surveyor:

Sir—In my judgment gun boats built to pass through the present locks, as now built, 96 feet by 18, would be of little service.

The boats should be at least 150 feet in length and 29 or 30 feet breadth, built upon a draft of water, say six feet light and eight feet loaded.

Very truly yours, B. F. DELANO."

The tonnage of a boat built with these dimensions would be about 380 or 400 tons.

The Federal Government are constructing gun boats for sea coast service, of the following dimensions: extreme length, 158 feet; extreme width, $27\frac{1}{3}$ feet; depth of hold, 12 feet; draft, when loaded, 10 feet.

Features as a Military Route.

The distance, via Lake Champlain and the St. Lawrence, from West Troy, is 395 miles, of which 218 miles pass through British territory by natural and artificial channels, the whole arranged in detail as follows:

West Troy to Whitehall, artificial channel	66	miles.
Whitehall to Crown Point, natural channel	39	do
Crown Point to Rouse's Point, do	72	do
Rouse's Point (Canada line) to Chambly, nat. channel	33	do
Chambly canal to St. Lawrence, artificial channel	12	do
Montreal to Ogdensburgh, artificial channel	41	do
natural channel	72	do
Ogdensburgh to Kingston, do	60	do
Total	395	miles.

Making, in the whole distance, 119 miles artificial, and 276 of natural channel."

Progress of the Canals in 1862.

Description of the Erie Canal, its Cost, Trade, Tonnage, and Maintenance.

Commencing in the city of Albany, at the head of tide waters, the Erie canal is carried over a ridge of slate rock by 18 double lift locks (110×18 ft.) to an elevation of $188\frac{1}{3}$ feet above tide water in 12 miles; continuing at this elevation, it reaches the Mohawk valley 14 miles from Albany, where it crosses the Mohawk river by the largest aqueduct on the canal, the length of the wooden trunk being 1,130 feet, resting on 29 stone piers, the towing path supported by 27 stone arches; its construction cost $331,000. Following the Mohawk valley, the canal recrosses the Mohawk river 24 miles from Albany, by an aqueduct similar to the other, with 14 stone arches, at an elevation of 229.80 feet above tide water.

Continuing along the Mohawk valley it passes the deep gorge forced through the hills by the river at Little Falls, over-

coming, at this place, an elevation of 40 feet in 1½ miles by four double lift locks. At Utica it reaches the "summit level," 112 miles from Albany, overcoming an elevation of 426.90 feet above tide water, by 46 double lift locks. The "summit level" (Utica to Lodi) is 56 miles long, next to the longest on the canal, and is supplied with water during the dry season by 10 feeders, that furnish in the aggregate, 24,090 cubic feet per minute, including the De Ruyter reservoir.

At Syracuse, the canal falls 27 feet, or to 400 feet above tide water. From this level the Oswego canal issues, following the valley of the Onondaga creek to the Seneca river, thence down the Seneca to Three-river point, thence the Oswego river to Lake Ontario by locks and dams; a descent of 154.85 feet in 38 miles, by 18 single locks, 110×18 feet.

Two miles west of Syracuse, the canal rises 6.90 feet, and continues on this level to Jordan, 190 miles from Albany. The main supply of water for this level, or from Syracuse to Port Byron, is from the Skaneateles lake reservoir, entering the canal at Jordon. This, with the Camillus feeder, comprises all the supply during the dry season, furnishing, in the aggregate, 9,020 cubic feet per minute.

At Port Byron the canal descends 16½ feet to the "Cayuga marsh level," 390 36-100 feet above tide-water. This portion is the most interesting piece of work on the whole line. The level extends from Port Byron to Clyde, 16 miles, 7 of which the canal is carried over the Cayuga marshes and low timbered lands, three feet below canal bottom,—the banks rising 13 feet above the marsh, and the canal 10 feet. The average amount of filling per mile, carried into the work with an average haul of ¾ of a mile, was two hundred and fifty thousand cubic yards.—The material was deposited without any preparation upon the natural surface, consisting entirely of vegetable mould, the depth of which to firm bottom is from thirty to sixty feet. The canal is carried over the Seneca river at the east side of the marsh by the *Richmond aqueduct*, a beautiful stone structure 894½ feet long, supported by 4,464 bearing piles ranging in length from 20 to 30 feet. It contains 10,893 cubic yards of masonry, 110,000 lineal feet bearing piles, and 1½ million feet board measure of plank and timber. The water in the canal is carried in a wooden trunk 50 feet wide in the clear, resting on two abutments, and 30 piers of masonry 11 feet above the top

DIAGRAMS of ENLARGED ERIE CANAL
showing the
General Plan of Slope & Vertical Walls

Wm. B. Taylor, State Engr. and Survr. — Scale 4 ft. per in — COOPER, DEL. — S. H. Sweet, Depy. State Engr. & Survr.

1862.

Detail Quantities in Towing path per Chain of 66 feet.

Slope Wall	46.67 C Yds
Pavement	7.33 D°
Embankment	523.18 D°
Lining	58.18 D°

Detail Quantities in Berme per Chain of 66 feet.

Slope Wall	34 57 C Yds
Pavement	0.00 D°
Embankment	463 22 D°
Lining	33.22 D°

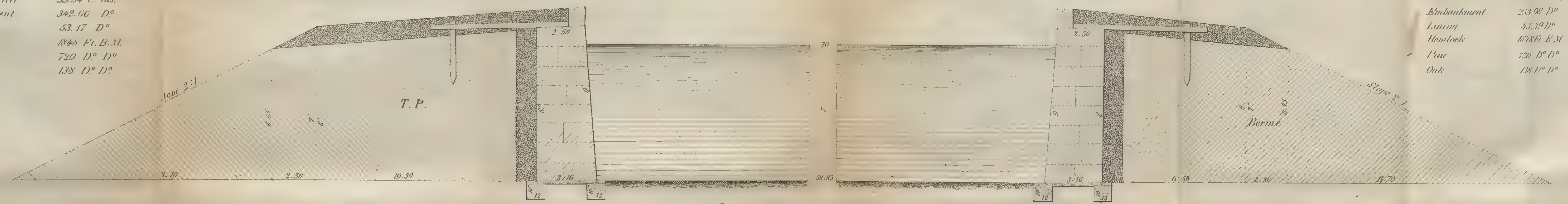
General Cross Section of Canal

Detail Quantities in Towing path per Chain of 66 feet

Vertical Wall	55.34 C. Yds.
Embankment	342.66 D°
Lining	53.17 D°
Hemlock	1848 Ft. B. M.
Pine	720 D° D°
Oak	138 D° D°

Detail Quantities in Berme per Chain of 66 feet

Vertical Wall	55.34 C Yds.
Embankment	253 98 D°
Lining	43.39 D°
Hemlock	1848 Ft. B. M
Pine	720 D° D°
Oak	138 D° D°



Cross Section of Canal through Cities

Comstock & Cassidy, Albany N.Y.

TABLE
COMPILED BY CHAS. TRUSDELL

Showing areas and contents of Borrowing pits and amount carried into the work between A & B

Nº	AREAS		CUBY^DS EMBANK^T	
1 BANK OF CAYUGA AND SENECA CANAL	1	00	2	567
2	0	15		746
3	0	20	2	672
4	1	50	18	061
5	2	30	27	292
6	0	30	2	307
7	2	00	7	247
8	0	40	5	933
9	3	00	25	340
10	0	77	8	113
11	0	34	3	700
12	0	30	2	050
13	1	17	4	054
14	0	25		744
15	0	35	2	613
16	0	90	5.	310
17	10	25	171	393
18	2	00	17	930
19	0	30	2.	171
20	2	00	10.	315
KIPP'S ISL^D W½ E½	6.30	5.52	61	718
Total	41	30 ACRES	382	539 CY^DS

of the foundation. The towing-path is supported by 31 stone arches, each 22 feet span. The foundation covers an area of two acres. The work was commenced in January, 1849, and brought into use in the spring of 1856. It was planned and constructed under the supervision of Van R. Richmond, late State Engineer and Surveyor, and stands a monument to the skill of its projector. It is the second in size of its kind on the canal.

(See following map and sketches of the canal and aqueduct.)

After leaving the marshes, the canal rises and follows the valley of Clyde river to Lyons; thence up the valley of Mud creek to Macedon, thence across the "Perrinton swamp" to the valley of Irondequoit, the passage of which was a very formidable undertaking. The width of the valley crossed by the enlarged canal is nearly eight miles shorter than the old canal. The surface of the ground is from 20 to 80 feet below canal bottom. The heaviest mile section contains 1½ million cubic yards of filling.

Leaving the Irondequoit, the canal passes over to the valley of Genesee, crossing the Genesee river at Rochester, by a stone aqueduct 920 feet in length, supported by six beautiful stone arches, each 52 feet span. It was constructed at an expense of $500,000. The canal at Rochester has an elevation of 509 86-100 feet above tide-water.

From one and a half miles west of Rochester to Lockport, occurs the longest level on this canal, being 63½ miles. The bottom of the canal between these points rises from Rochester with a grade of 2 728-1000 feet. The size of the prism or water-way of the canal at Rochester is 71 feet surface, 53 feet on bottom, and 7¼ feet deep, regularly increasing to a size of prism at Lockport to 98 feet surface, 79 on bottom, and 7½ feet deep.

At Lockport, 321 miles from Albany, the canal rises by 5 combined double locks, 55 83-100 feet in a distance of 630 feet, to an elevation of 568 42-100 feet above tide-water. They were constructed at an expense of $686,000.

From Lockport to the head of "Rock cut" 3 miles, the size of the prism is 62 feet on surface, 60 feet on bottom, and 9 feet deep; and to Pendleton, 4 miles further, the canal is 100 feet on surface, 77½ on bottom, and 9 feet deep. From Pendleton to Tonawanda, 12 miles, the canal occupies the Tonawanda creek, 200 feet wide, and a channel 9 feet deep. To Black Rock, 8

miles further, the canal is 80 feet on surface, 60 feet on bottom, and 9 feet deep; the canal entering Lake Erie at Buffalo, 350½ miles from Albany, 568½ feet above tide-water, with a total lockage of 654 80-100 feet = 1 86-100 feet per mile.

The change from the ordinary size of the canal, west of Rochester, was for supplying the canal with water from Lake Erie to the Seneca river, a distance of 142 miles, without resorting to the Genesee river, except in temporary obstruction, when the latter with the Oak orchard feeder are used.

Structures.

The following statement exhibits the extent of bridging, iron and wood superstructures, across the canal.

1st—Iron Bridges.

PLAN.	Designing engineer.	No. of bridges.	Aggregate length.	Square ft. bridge flooring.
Arch truss	Squire Whipple	116	10,113	309,457
Swartz	Samuel Swartz	7	642	25,680
Bollman	—— Bollman	[illegible]	825	36,750
Arch tubular truss	Nelson J. Beach	6	471	11,775
Simms	—— Simms	3	264	8,844
Heath	George Heath	1	77	5,236
Suspension, Foot bridge		7	707	3,322
Trapezoidal, Foot bridge		1	80	520
Riders, Hildreth, Wright	Berger & Vibbard	8	801	36,285
Total		158	13,980	437,869

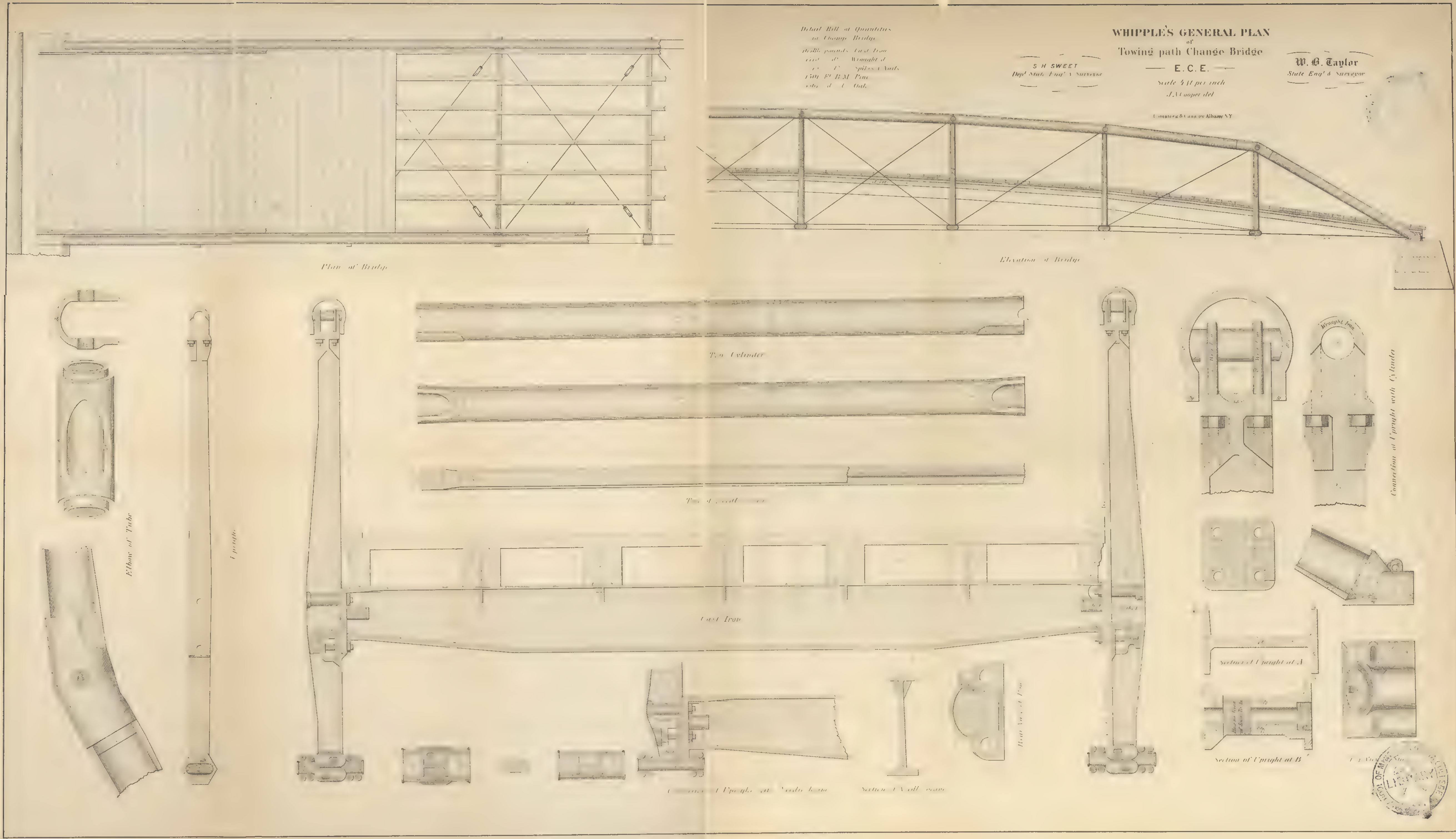
2d—Wood Bridges.

PLAN.	Designing engineer.	No. of bridges.	Aggregate length.	Square ft. bridge flooring.
Six-brace bridge	Squire Whipple	280	22,695	351,772
Covered	Jervis & Hutchinson	30	2,345	45,337
Beardsley iron chords	S. H. Sweet	14	1,107	22,140
Lattice	O. W. Childs	18	1,588	32,954
Suspension, Foot bridge		11	1,055	5,275
Others, old plans	Jervis, Mills & Hutchinson	29	2,786	58,784
Total		382	31,576	516,259

From the foregoing statement, the total length of bridges would reach 8⅔ miles, and the area of bridge flooring cover 22 acres. The aggregate constant sustaining power is equal to 57,247 tons.

The following statement comprises all the structures on the Erie canal, including the bridges, with their approximate cost:

AN



Detail Bill of Quantities of Change Bridge
WHIPPLE'S GENERAL PLAN
of
Towing path Change Bridge
E.C.E.
Scale 4 ft per inch
S H SWEET
W. B. Taylor
State Eng' & Surveyor
Plan of Bridge
Elevation of Bridge
Elbow of Tube
Cast Iron
Section of Upright at A
Section of Upright at B
Connection of Upright with Cylinder

Quantities.	Kind of structures.	Price.	Amount.
437,869	Square feet flooring in 158 iron bridges	81 c.	$354,673 89
516,259	do do 382 wood bridges	38 c.	196,178 42
540 sets	Bridge abutments	$2,750	1,485,000 00
540 do	do embankments, &c	1,800	972,000 00
57 do	Double locks, aggregate length 9,833 feet	73,850	4,209,450 00
14 single	Locks, do do 2,415	31,560	441,840 00
2 do	Guard locks, do do 345	23,000	46,000 00
5 do	Weigh locks, do do 737	47,036	235,180 00
24,235	Lineal feet of trunk in 32 aqueducts	310	7,512,850 00
2,363	do waste walls, waste weirs	42	99,246 00
11	Stop gates	2,000	22,000 00
190	Stone arch culverts, aggregate spans 1,523	4,000	760,000 00
94	Composite do do do 435	1,700	159,800 00
	Total approximate cost of structures		$16,494,218 31

Length of longitudinal structures:

Locks occupying channel of canal (exclusive weigh locks)	2.41	miles.
Aqueducts occupying channel of canal	4.59	do
Total	7.00	do

Length structures crossing canal:

Iron bridges $2\frac{2}{3}$ miles, wood bridges 6, total bridges	$8\frac{2}{3}$	miles
Composite culverts 2 miles, stone arch 5, total culverts	7	do
Waste weirs; total length waste walls and abutments	$\frac{2}{3}$	do
Total	$16\frac{1}{3}$	do

Feeders.

The following embraces all the available feeders for supplying the Erie canal with water during the dry season, with approximate cost of each, paid from enlargement fund:

NAME OF FEEDER.	When brought into use.	Source of supply.	Miles entering the canal from Albany.	Supply cubic feet per minute.	Total cost of feeder.
Rexford Flatts feeder	1844	Mohawk river	26	10,979	$25,000 00
Schoharie creek feeder	1845	Creek	51	6,800	30,000 00
Rocky rift feeder	1856	Mohawk river	78	10,602	190,000 00
Little Falls feeder	1843	Mohawk river	87	12,643	12,500 00
Ilion creek feeder	1838	Creek	98	800	1,000 00
Chenango canal	1836	Through lock	110	750	....
Butts' creek	1838	Creek	124	1,400	530 00
Mohawk feeder at Rome	1858	Mohawk river	125	10,979	25,976 36
Black River canal at Rome	......	Through lock	125	708	....
Oneida creek feeder	1835	Creek	140	1,500	34,498 00
Cowassolan creek feeder	1858	Creek	143	320	10,089 65
Erieville reservoir	1850	Reservoir	152	2,130	36,837 03
Chittenango creek feeder	1840	Creek and outlet	152	250	7,555 33
Cazenovia lake reservoir	1857	Reservoir	152	2,631	10,884 73
De Ruyter reservoir, through	1863	Reservoir	158	3,972	150,000 00
Limestone creek	1852	Creek and outlet	158	210	14,871 30
Orville (Butternut creek) feeder	1858	Creek	161	450	45,000 00
Camillus feeder	1843	Creek	175	1,500	11,327 68
*Skaneateles lake reservoir	1844	Reservoir	185	7,520	14,927 55
†Genesee river feeder	1826	Genesee river	259	350	42,750 54
Genesee Valley canal	1842	Through lock	259	861	....
Oak Orchard creek feeder	1840	Creek	303	1,400	29,722 42
Lake Erie, Buffalo	1856	Lake	$350\frac{1}{2}$	35,000	....
Total cost enlargement feeders				113,755	$693,470 59
Total cost original Erie canal feeders				....	101,147 00

Cost of the Erie canal, including Enlargement and Land Damages, also the estimated cost of same by the several State Engineers.

OLD ERIE CANAL.

Estimated cost at engineers' prices.		Estimated cost at cost prices.	
When made.	Amount of estimates.	When made.	Amount of estimates.
March 11, 1811	$5,000,000 00	December, 1821	$5,941,960 00
March 11, 1817	4,926,738 00	Actual cost, Oct. 26, 1825	7,143,477 00
ENLARGEMENT.			
October 20, 1835	12,448,541 00	January 1, 1850	25,144,426 63
March 25, 1839	23,402,836 00	Actual cost, Jan. 1, 1863	31,834,041 30

* Supply measured at the outlet, 11,280 cubic feet per minute; 3,760 cubic feet being lost through sink holes while passing to canal.

† Ordinary flow. Its capacity is equal to 7,380 cubic feet per minute.

Progress of the enlargement each year from 1850. *Estimated cost and actual payments.*

BY WHOM MADE.	Year ending Sept. 30.	Am't estimated to complete, including land damages given in Canal Appra'rs report.	Total payments by the Canal Commissioners for construction and land damages.	Estimated cost of enlargement.
H. C. Seymour......	1851	$11,101,233 20	$16,611,798 86	$27,713,032 06
Wm. J. McAlpine ...	1852	11,151,111 86	17,524,947 50	28,676,059 36
do ...	1853	10,349,702 32	18,080,087 47	28,429,789 79
Jno. T. Clark........	1854	10,383,438 36	18,662,530 58	29,045,968 94
do	1855	6,490,972 09	20,666,831 09	27,157,803 18
Silas Seymour........	1856	4,643,339 29	23,835,507 98	28,478,847 27
do	1857	2,761,712 11	26,038,213 31	28,799,925 42
Van R. Richmond....	1858	2,044,594 73	27,404,341 59	29,448,936 32
do	1859	1,296,507 58	27,833,336 82	29,129,844 40
do	1860	1,073,871 53	30,043,552 93	31,117,424 46
do	1861	615,509 35	30,604,691 31	31,220,200 66
William B. Taylor....	1862	*549,344 91	31,284,344 91	31,834,041 30

* $136,873.86 of this amount is for work, and the rest is for land damages.

Total cost of Construction, Repairs, Collection, &c., of the Erie Canal, in detail, also per mile.

Classification.	Total cost.	Cost per mile.
Original Erie canal, 363 miles long	$7,143,789 86	$19,679 87
Enlargement of the Erie, 350½ miles long	31,834,041 30	90,824 65
Erie canal, including enlargement, at 350½ miles	38,977,831 16	111,206 30
Same, exclusive of feeders, structures, and land damages	18,439,848 87	52,610 10
Feeders for the canal and enlargem't	794,617 59	2,267 09
Structures for old canal and enlargement	16,494,218 31	47,059 05
Land damages for old canal and enlargement	3,249,146 39	9,270,06
Interest on loans during construction, 1817 to 1826, $1,602,376.54, and 1835 to 1863 enlargement	9,696,461 12	27,664 70
*Balance of total interest on loans,	3,817,623 46	10,891 90
Total cost constructing, including interest on loans	$52,491,915 74	149,762 90
†Total cost repairs from 1827 to 1862 inclusive	10,995,333 52	31,370 90
‡Total paid collectors, inspectors and weigh-masters	1,410,741 79	4,025 00

* Where the interest of the Champlain and Erie are given together, the amount belonging to the Erie is obtained by a proportion of its cost to that of the Champlain.

† The repairs for the Champlain canal are assumed at 15¼ per cent. of the total cost of repairs of the Erie and Champlain canals.

‡ 89½ per cent. of the Erie and Champlain canals is taken for the Erie.

An interesting exhibit of the average tonnage of the boats, the time necessary to make a passage, and the cost to bring a barrel of flour from Buffalo to Albany, of the lockages at Alexander's lock, and the total tons delivered at tide-water from the Erie canal, is as follows :

Year.	Average cargo of boat	Days' time between Buffalo and Albany.	Toll and freight on a barrel flour.	Lockage at Alexander's lock.	Tons delivered at tide-water from Erie canal.
1841	41	9	71 cts.	30,320	532,520
1844	49	7½	60 do	28,219	799,816
1847	67	10½	77 do	43,957	1,431,252
1848	71	9	58 do	34,911	1,184,337
1849	68	8¾	56 do	36,918	1,266,724
1850	76	9	58 do	38,444	1,554,675
1851	78	8½	49 do	40,396	1,508,677
1852	80	9	53 do	41,572	1,644,699
1853	84	9	56 do	42,967	1,851,438
1854	94	8½	52 do	35,981	1,702,693
1855	92	8½	52 do	30,873	1,420,715
1856	100	8½	60 do	31,223	1,587,130
1857	100	8½	46 do	22,182	1,117,199
1858	126	8½	34 do	23,474	1,496,687
1859	143	8½	31 do	20,274	1,451,333
1860	140	8½	42 do	32,439	2,276,061
1861	157	8½	46 do	31,179	2,449,609
1862	---	---	--	------	--------

The lockages in 1860 exceed those of any year since 1854. The lockages, however, will not increase in proportion to the increased tons delivered at tide-water. There were 573,368 more tons delivered at tide-water in 1860, than in 1854, and 746,916 more in 1861 than in 1854, with 3,542 less lockages in 1860, and 4,802 in 1861.

General view of the progress of the trade of the Erie canal, with the cost of transportation, from 1824 *to* 1862, *inclusive.*

YEAR.	Tons going from tide water.	Tons arriving at tide water.	Total lockages at Junct'n and Alexander's lock.		No. boats arrived at and cleared from New York, Albany and Troy.	COST OF TRANSPORTATION PER TON.			
						Albn'y to Buffalo.		Buffalo to Alb'ny.	
						For tolls	For tolls and freight.	For tolls	For tolls and freight.
1824	......	....	6,166		8,760	....	....	....	....
1825	......	....	10,985		13,110	....	....	....	....
1826	35,435	....	15,156		......	....	....	....	....
1827	......	....	13,004		......	....	....	....	....
1828	56,797	....	14,579		23,662	....	....	....	....
1829	52,621	....	12,619		21,490	....	....	....	....
1830	70,154	....	14,674		23,874	$10 22	$20 00	$5 11	$9 07
1831	86,945	....	16,284		26,882	10 22	19 80	5 11	8 89
1832	......	....	18,601	Alexander's lock.	25,826	10 22	20 00	5 11	9 26
1833	119,468	....	20,649		31,460	8 76	14 80	3 65	8 15
1834	114,608	....	22,911		32,438	6 57	16 40	3 28	7 68
1835	128,910	753,191	25,798		36,690	6 57	16 00	3 28	6 29
1836	133,796	696,347	25,516		34,190	6 57	21 00	3 28	7 13
1837	122,130	611,781	21,055		31,082	6 57	18 60	3 28	7 50
1838	142,802	640,481	25,962		32,120	6 57	17 80	3 28	6 76
1839	142,035	602,128	24,234		31,882	6 57	17 80	3 28	6 94
1840	120,586	669,012	26,987		30,456	6 57	16 60	3 28	7 50
1841	162,715	774,334	30,320		33,782	6 57	12 20	3 28	6 57
1842	123,294	666,626	31,682		32,840	6 57	13 20	3 28	6 02
1843	143,595	836,861	31,348		32,826	6 57	11 20	3 28	5 56
1844	176,737	1,019,094	38,313		38,786	6 57	13 00	3 28	5 56
1845	195,000	1,204,943	39,099		40,094	6 57	9 60	3 28	6 57
1846	213,295	1,362,319	43,202		42,936	4 80	8 00	2 92	5 92
1847	288,261	1,744,283	54,131		51,634	4 80	7 80	2 92	7 13
1848	329,557	1,437,905	44,076		43,018	4 80	7 80	2 92	5 37
1849	315,550	1,579,946	47,315		46,520	4 80	7 80	2 92	5 18
1850	418,370	2,033,833	51,245		46,880	4 80	7 20	2 92	5 48
1851	467,961	1,977,151	54,257		53,316	4 40	6 20	2 19	4 71
1852	521,527	2,234,822	55,050	Junction and Alexander's lock.	55,166	2 92	5 20	2 19	4 90
1853	584,141	2,505,797	56,280		55,732	2 92	5 60	2 19	5 18
1854	531,831	2,223,743	50,674		48,825	2 92	5 00	2 19	4 81
1855	504,696	1,895,593	44,401		41,110	2 92	5 00	2 19	4 81
1856	573,733	2,123,469	47,096		44,628	2 92	5 40	2 19	5 56
1857	340,170	1,617,187	31,473		35,506	2 92	4 80	2 19	4 26
1858	287,073	1,985,142	32,386		33,118	1 46	2 80	1 46	3 14
1859	317,459	2,121,672	29,514		29,788	70	2 40	1 41	2 87
1860	373,735	2,854,877	41,598		40,608	1 40	2 40	1 41	3 88
1861	340,736	2,980,144	37,786		39,526	1 40	2 20	1 76	4 26
1862	......	....	......		....	....	....	....	....

Detail statement of the cost of construction of the Champlain canal and feeder, up to Sept. 30, 1862.

From Wm. Jerome's field book, the cost of the canal is given, up to 1832, inclusive, as follows:

Cost of canal	$828,416 12
Lock and dam at Troy	92,595 01
Total cost of original construction, as per Wm. Jerome	$921,011 13
Amount expended enlarging and improving Glens Falls feeder, under act May 25, 1836, as per Commissioners' report for 1843	91,944 00
Rebuilding and enlarging locks from 1854 to 1859, inclusive	410,642 00
Improving and stopping leaks in Glens Falls feeder, act chap. 213, Laws 1860	46,808 00
Weigh lock, culvert, house and scales at Waterford	29,115 39
Amount done and to be done enlarging locks under cont., 1862	49,097 76
Improving 16 and 5 mile levels—driving piles, &c.	18,180 00
Cost of construction up to Sept. 30, 1862	$1,566,798 28
Land damages from 1851 to 1863	82,208 80
do 1837 to 1851	64,920 98
do 1817 to 1837=$\frac{1}{6}$ of Erie and Champlain	32,134 57
Total cost, with land damages	$1,746,062 63
Total interest on loans, being $6\frac{1}{4}$ per cent. of total interest for Erie and Champlain, and enlargement of the Erie	900,939 71
Total cost, with interest on loans	$2,647,002 34
Total expended for repairs and collection, &c., from 1827 to Sept. 30, 1862, being $15\frac{1}{2}$ per cent. of the whole for the Erie and Champlain	2,296,358 93
Total cost, construction, repairs, collection, &c., with interest on loans	$4,943,361 27

Total Cost of Construction and Repairs of the New York State Canals, including Land Damages and Engineering.

September 30, 1862.	Total paid for repairs.	Original cost of canal.	Cost with improvement and land damages.	Cost with interest on loans.
Erie canal	$10,995,333 52	$7,143,789 86	$38,977,831 16	$52,491,915 74
Oswego canal	1,244,442 48	565,437 35	3,077,429 57	3,612,825 11
Cayuga and Seneca c'l	486,582 77	214,000 00	1,347,149 26	1,584,554 09
Champlain c'l & feeder	2,016,895 00	921,011 13	1,746,062 63	2,647,002 34
Black River do	181,887 70	2,954,848 64	3,157,296 38	4,239,566 75
Genesee Valley canal.	612,336 01	5,342,753 20	5,663,183 99	9,408,896 19
Chenango canal	506,681 79	2,316,186 00	2,491,351 68	3,754,143 80
Chemung c'l and feeder	756,198 18	314,395 00	1,052,343 51	1,623,693 42
Oneida river improv'nt	23,908 41	79,346 00	107,959 55	173,348 54
Oneida Lake canal	79,406 49	*78,829 85	50,000 00	74,916 09
Seneca river towing path and B. canal	9,662 03	14,846 00	16,585 13	16,585 13
Crooked Lake canal	127,817 37	156,776 00	306,103 28	418,890 96
Totals	$17,041,151 75	$20,102,237 03	$57,993,296 14	$80,046,338 16

* This amount was paid by the company as reported by the petitioners in their application to the State to purchase the same. See Senate Document No. 16, 1837. They reported the cost of the canal at $64,886.37, and the feeder $13,938.48.

The following statement shows tne net gain and loss upon each and all the New York State Canals, from 1817 to Sept. 30, 1862.

NAME OF CANAL.	Total amount tolls received from completion of canal, to Sept. 30, 1862.	Total expenditures for repairs, collectors, inspectors and weighmasters.	Surplus and deficiencies.
Erie canal	$71,783,670 65	$12,518,860 03	$59,264,810 62*
Oswego canal	2,022,365 73	1,450,403 37	571,962 36*
Cayuga and Seneca canal	694,280 27	557,934 64	136,345 63*
Champlain canal and feeder	4,127,646 60	2,296,358 93	1,831,287 67*
Black River canal	71,536 38	310,233 39	238,697 01†
Genesee Valley canal	538,050 77	849,284 96	311,234 19†
Chenango canal	509,374 78	690,471 40	181,096 62†
Chemung canal and feeder	375,819 64	935,996 26	560,176 62†
Crooked Lake canal	40,216 01	185,338 03	145,122 02†
Oneida Lake canal	65,130 30	113,024 28	47,893 98†
Oneida river improvement	191,139 08	24,730 00	166,409 08*
Baldwinsville canal and Seneca towing path	1,201 49	11,185 45	9,983 96†
	$80,420,431 70	$19,943,820 74	$60,476,610 96†

NOTE—The sign * is for surplus, and † for deficiencies.

Total receipts by the Commissioner of the Canal Fund on account of all the New York State Canals, from 1817 *to Sept.* 30, 1862.

Total am't tolls received from railroads & canals	$81,088,958 45
Salt duty	2,055,458 06
Vendue duty	3,592,039 05
Steamboat tax	73,509 99
Rent of surplus water	89,421 74
Total canal receipts proper	$86,899,387 29
Avails of loans	$56,331,755 29
do temporary loans	3,406,467 00
Total amount loans applied to construction, &c.	$59,738,222 29
Total canal receipts and loans applied to construction, &c	$146,637,609 58
Avails canal revenue certificates	$1,512,390 75
Interest on investments and deposits	3,723,417 12
Total from canal paper	$5,235,807 87
Receipts from taxes	$8,306,881 94
Miscellaneous receipts	1,569,709 38
Erie and Champlain canal for deficiencies	4,971,840 12
do do B. River canal and Erie feeder	290,097 66
Sales of land	320,518 15
General Fund for deficiencies	1,386,498 88
Sum total receipts	$168,718,963 48

Total expenditures on all the Canals by the Commissioners of the Canal Fund, from 1817 *to Sept.* 30, 1862.

Classification.	Amounts.
By Canal Commissioners for construction, land damages and engineering	$60,824,627 31
Seneca Lake Navigation Co., and purchase of Oneida Lake canal	103,871 88
Total interest on loans contracted for construction, &c	31,821,403 12

Paid on principal of loans contracted for construction, &c	$31,610,719 56
Paid on principal of temporary loans and premiums on investment	3,573,266 79
Black River canal for Erie canal feeder	290,097 66
Total amount paid for construction, damages, &c	$128,223,986 32
Total paid for repairs, collection and weigh masters	20,049,427 79
Miscellaneous payments	2,512,386 10
Total construction and management	$150,785,800 31
To the General Fund and Fund Debt	8,372,019 39
Deficiencies of lateral canals and Oneida river improvement	4,971,840 12
Total payments	$164,129,659 82

Dimensions of the New York State canals, with cost of each per mile, September 30th, 1862.

NAME OF CANAL.	When authorized.	When completed.	Length in miles.	Size of Canal.			No. & Size Locks.			Cost per mile, canal improvements and land damages.
				Width on surface.	Width on bottom.	Depth of water.	Number of locks.	Length between quoins.	Width in clear.	
Erie canal	1817	1825	363	40	28	4	83	90	15	$19,679 87
do enlargem't same	1835	1862	350½	70	56	7	71	110	18	90,824 65
Oswego canal	1825	1828	38	40	24	4	18	90	15	14,880 00
do enlargem't same	1847	1862	38	70	56	7	18	110	18	66,105 00
Cayuga and Seneca canal	1825	1828	21	40	24	4	10	90	15	10,190 50
do enlargem't same	1836	1862	23	70	56	7	11	110	18	49,282 00
Champlain canal	1817	1822	66	50	35	5	20	100	18	
do Glens Falls feeder	1822	1837	12	50	35	5	13	100	18	21,556 32
do pond above Troy dam	1822	1837	3	......	......	.....	1	.....		
Black River canal and feed'r	1836	1849	50	42	26	4	109	90	15	60,000 00
do improvement	1849	1861	42¼	......	......	.....	1	110	18	3,707 00
Genesee Valley canal	1836	1861	124¾	42	26	4	112	90	15	45,305 00
Chenango canal	1833	1836	97	40	24	4	116	90	15	25,684 00
Chemung canal and feeder	1829	1831	39	42	26	4½	53	90	15	26,983 00
Oneida river improvement	1839	1850	20	80	60	4½	2	120	30	5,397 00
Oneida Lake canal	1832	1836	7	40	24	4	7	90	15	7,143 00
Baldwinsville canal and Seneca towing path	1838	1839	5¾	40	24	4	1	90	15	2,884 00
Crooked Lake canal	1829	1833	8	42	26	4	27	90	15	38,262 00

Statement of total length navigable miles of canals, feeders and rivers, with lakes, connected artificially with canals in New York State.

	Miles.
Total length of artificial canals and feeders	886½
Length Hudson river, New York to Waterford	155
Lake Champlain, Whitehall to Rouse's Point	111
Oneida lake	22
Cayuga lake	39
Seneca lake	35
Crooked lake	19
Total	1,267½

COST OF TRANSPORTATION.

Statement showing the tons of total movement for nine years, the tolls paid, freight paid to carrier, and the average cost per ton per mile.

New York State Canals.

YEAR.	Tons moved one mile.	Amount of tolls.	Amount of tolls and freight.	Cost per ton per mile.	
				For tolls.	For tolls & freight.
1853...	700,389,933	$3,204,718 00	$7,393,884 00	4.57 mills.	1.05 cts.
1854...	668,559,044	2,773,566 00	5,782,855 00	4.15 "	0.865 mills
1855...	619,170,651	2,085,077 00	5,841,420 00	3.36 "	0.943 "
1856...	592,009,603	2,748,212 00	6,573,225 00	4.22 "	1.11 cts.
1857...	484,750,864	2,045,641 00	3,876,000 00	4.21 "	0.80 mills
1858...	564,842,095	2,110,754 00	4,502,437 00	3.71 "	0.80 "
1859...	544,309,072	1,723,945 00	3,665,806 00	3.16 "	0.677 "
1860...	809,524,506	3,009,597 00	8,049,450 00	3.72 "	1.00 cts.
1861...	863,623,507	3,908,785 00	9,369,378 00	4.53 "	1.08 "
1862...	.....	.....	.....	.....	.....

COST OF TRANSPORTATION.

Statement showing the tons of total movement and mileage on the New York Central and New York and Erie Railroads, and freight on the same, and the average cost per ton per mile.

Railroads.

YEAR.	NEW YORK CENTRAL RR.			NEW YORK AND ERIE RR.		
	Tons moved one mile.	Receipts for freight.	Per ton per mile	Tons moved one mile.	Receipts for freight.	p'r ton pr m'e
			cents.			cents.
1853	54,701,350	$1.838,830 00	3.36	101,626,522	$2.537,214 00	2.49
1854	81,168,080	2,479,820 00	3.05	130,808,034	3,369,590 00	2.57
1855	99,605,836	3,189,603 00	3.20	150,673,998	3,653,002 00	2.43
1856	145,733,678	4,328,041 00	2.97	183,458,046	4,545,782 00	2.48
1857	145,873,776	4,559,276 00	3.13	167,100,850	4,097,610 00	2.45
1858	142,691,178	3,700,270 00	2.59	165,895,635	3,843,311 00	2.32
1859	157,136,000	3,337,148 00	2.13	147,127,039	3,195,870 00	2.17
1860	199,231,392	4,095,934 00	2.06	214,084,395	3,946,410 00	1.84
1861	237,392,974	4,664,449 00	1.96	251,350,127	4,351,464 00	1.73
1862	296,963,492	6,607,330 96	2.22	351,092,285	6,642,914 68	1.89

General view of tolls, trade and tonnage, with percentage of increase and decrease in each fiscal year, on the New York State Canals.

YEAR.	MILES RUN BY FREIGHT BOATS.		TOTAL MOVEMENT.		TOTAL TOLLS COLLECTED.	
	Per cent increase.	Miles run.	Tons.	Per ct. incr'e and decrease	Tolls.	Per ct. inc're and decrease
1836	....	....	1,310,807	....	$1,614,336 43	....
1837	....	5,556,950	1,171,296	10.7†	1,292,623 38	20.†
1838	7.7†	5,126,800	1,333,011	14.*	1,590,911 07	23.2*
1839	11.4*	5,785,850	1,435,713	7.7*	1,616,382 02	1.6*
1840	3.*	5,952,300	1,417,046	1.3†	1,775,747 57	10.*
1841	19.6-10*	7,103,580	1,521,661	7.6*	1,034,882 82	41.6†
1842	13.1-10†	6,173,200	1,236,931	19.†	1,749,197 52	69.9*
1843	6.7*	6,586,700	1,513,439	23.*	2,081,590 17	19.2*
1844	19.2*	7,841,750	1,816,586	20.*	2,446,374 52	17.5*
1845	1.1*	7,924,250	1,977,565	9.*	2,646,181 87	8.1*
1846	14.2*	9,065,450	2,268,662	14.5*	2,756,120 89	4.5*
1847	30.*	11,733,250	2,869,810	27.*	3,635,380 00	31.9*
1848	18.2†	9,633,850	2,796,230	2.6†	3,252,212 19	10.6†
1849	5.3*	10,153,350	2,894,732	3.6*	3,268,826 03	.5*
1850	5.5*	10,718,100	3,076,617	6.4*	3,273,899 22	.2*
1851	11.4*	11,926,950	3,582,733	16.6*	3,329,727 00	1.8*
1852	3.2*	12,306,950	3,863,441	7.8*	3,118,244 02	6.4†
1853	.2*	12,327,050	4,247,852	10.*	3,204,717 99	2.8*
1854	8.7†	11,244,200	4,165,862	2.†	2,773,566 35	13.4†
1855	14.†	9,671,450	4,022,617	3.4†	2,805,076 10	1.2*
1856	.1†	9,656,700	4,116,082	2.3*	2,748,211 67	2.†
1857	23.7†	7,374,850	3,344,061	19.†	2,045,640 75	25.6†
1858	7.*	7,886,100	3,665,192	10.*	2,110,753 82	3.2*
1859	11.1†	7,010,750	3,781,684	3.2*	1,723,944 97	18.5†
1860	41.*	9,930,300	4,650,214	22.8*	3,009,597 04	74.6*
1861	4.2*	10,351,350	4,507,635	3.1†	3,908,784 81	30.1*
1862	....	....	4,800,000	6.5*	4,790,518 09	22.4*

NOTE.—The sign * indicates increase, and † decrease of percentage.

TABLE *showing the tendency of lockages upon each division of the Erie Canal, with the percentage of decrease as compared with the lockages on each.*

YEAR.	DOUBLE ENLARGED LOCKS.				SINGLE ENLARGED LOCKS.		
	E. DIVISION.	MIDDLE DIVISION.			WESTERN DIVISION.		
	Lock 3 miles west of Schenec'dy	Syracuse lock.	Geddes lock.	Percent'ge less than on the E. division.	Lockport locks.	Black Rock guard lock.	Percent'ge less than M. div'n.
1837	21,055	18,181	15,207	21.	10,041	11,173	36.5
1838	25,962	20,383	18,557	25.	....	....	....
1839	24,234	....	....	....	....	....	....
1840	26,987	....	....	....	....	....	....
1841	30,320	....	....	....	....	....	....
1842	22,869	19,397	16,069	22.4	11,697	11,097	36.
1843	23,184	21,165	17,447	16.5	11,697	12,769	36.8
1844	28,219	25,198	20,044	20.	12,994	14,554	39.
1845	30,452	28,203	23,052	15.9	15,665	14,296	41.7
1846	33,431	32,212	25,225	14.1	20,033	16,343	36.6
1847	43,957	39,149	31,650	19.7	26,327	27,295	24.2
1848	34,911	34,760	29,066	8.4	20,255	19,470	38.
1849	36,918	38,634	28,740	8.7	20,124	18,181	23.
1850	38,444	41,170	27,799	10.1	21,111	20,103	11.
1851	40,396	....	29,535	10.	25,094	20,515	36.
1852	41,572	38,933	29,952	17.1	25,164	20,830	33.2
1853	42,967	35,559	29,332	24.5	20,839	19,476	37.1
1854	35,981	32,813	29,088	14.1	23,152	18,632	32.5
1855	30,873	29,365	28,858	4.1	20,752	18,245	34.3
1856	31,223	28,547	20,788	21.3	18,538	15,894	30.
1857	22,182	25,699	16,337	5.3	16,374	12,503	31.4
1858	23,474	27,054	16,957	6.6	15,117	13,050	36.1
1859	21,905	22,547	....	21.	11,700	10,695	35.2
1860	32,439	32,862	21,880	15.6	19,585	16,815	33.6
1861	31,179	29,510	24,283	14.	25,261	20,549	14.8
1862	....	....	....	....	....	....	....

Cost of all the weigh locks on the New York State Canals.

Contractor for scale.	Location of lock.	Cost of buildings and scales.			Total, including lock and culverts.
		Buildings.	Scales.	Total buildings and scales.	
Sampson & Tibbits Scale Co.	Waterford	$823 00	$3,500 00	$4,323 00	$29,114 00
	Albany	8,275 00	4,896 00	13,171 00	35,004 00
	Troy	8,230 00	4,000 00	12,230 00	46,674 00
Squire Whipple.	Utica	8,275 00	4,896 00	13,171 00	56,593 00
Fairbanks & Co.	Syracuse	8,283 00	4,050 00	12,333 00	38,466 00
Duryea & Forsyth.	Rochester	6,671 00	4,896 00	11,567 00	51,442 00

Estimate submitted to the Convention in 1846, *of the ability of the canals to provide for the Sinking Fund charges.*

YEAR.	1. Tolls of 1846, increased at 3.02 per cent annually.	2. Estimated ordinary annual expenses.	3. Net revenue.
1846	$2,757,178 08	$600,000 00	$2,157,178 08
1847	2,840,444 86	600,000 00	2,240,444 86
1848	2,923,711 64	600,000 00	2,323,711 64
1849	3,006,978 42	600,000 00	2,406,978 42
1850	3,090,245 20	600,000 00	2,490,245 20
1851	3,173,511 98	600,000 00	2,573,511 98
1852	3,256,778 76	600,000 00	2,656,778 76
1853	3,340,045 54	600,000 00	2,740,045 54
1854	3,423,312 32	600,000 00	2,823,312 32
1855	3,506,579 10	600,000 00	2,906,579 10
	$31,318,785 90	$6,000,000 00	$25,318,785 90

This table shows the actual receipts and annual charges for repairs of canals for ten years, and the net revenue.

YEAR.	1. Actual tolls of canals, 10 years.	2. Actual annual repairs.	3. Net revenue.
1846	$2,842,214 13	636,353 01	$2,205,861 12
1847	3,473,484 60	641,650 08	2,831,834 52
1848	3,204,070 16	855,860 64	2,348,209 52
1849	3,442,906 62	685,803 91	2,757,102 71
1850	3,486,172 30	835,965 81	2,650,206 49
1851	3,722,163 11	907,730 20	2,814,432 91
1852	3,179,145,78	1,049,045 92	2,130,099 86
1853	3,168,546 51	1,098,476 92	2,070,069 59
1854	2,988,665 21	1,237,866 20	1,750,799 01
1855	2,639,792 12	989,792 12	1,650,000 00
Actual	$32,147,160 54	$8,938,544 81	$23,208,615 73
Estimated	31,318,785 90	6,000,000 00	25,318,785 90
Difference	$828,374 64	$2,938,544 81	$2,110,170 17

STATEMENT.

Progress of the entire Canal Debt.

Fiscal year.	Borrowed.	Redeemed.	Canal debt at close of each fiscal year.
1817	$200,000 00	....	$200,000 00
1818	200,000 00	....	400,000 00
1819	400,000 00	....	800,000 00
1820	693,500 00	....	1,494,000 00
1821	1,400,000 00	....	2,895,500 00
1822	1,350,000 00	....	4,243,500 00
1823	1,656,000 00	....	5,899,500 00
1824	1,568,270 99	....	7,467,770 99
1825	270,000 00	....	7,737,770 99
1823	377,000 00	$270,000 00	7,844,770 99
1827	....	94,615 00	7,750,155 99
1828	210,000,00	20,000 00	7,940,155 99
1829	87,000,00	321,142 99	7,706,013 00
1830	150,000 00	30,977 14	7,825,035 86
1831	240,263 00	9,653 00	8,055,645 86
1832	....	....	8,055,645 86
1833	95,737 00	1,478,376 57	6,673,006 29
1834	950,000 00	588,006 61	7,034,999 68
1835	....	706,943 49	6,328,056 19

STATEMENT,

Showing the progress of the Canal Debt, the amount paid for interest, on loans and to the Canal Commissioners; also the Surplus Revenues in each fiscal year, from 1836 *to* 1862.

FISCAL YEAR.	PROGRESS OF THE CANAL DEBT.			PAID		
	Borrowed.	Redeemed.	Canal debt at close of each fiscal year.	Interest on loans.	Canal Commissioners on all the canals.	Surplus revenues in each fiscal year.
1836	$650,000 00	$651,249 46	$6,326,806 73	$328,744 86	$977,550 82	$1,130,856 15
1837	810,920 22	971,644 93	6,166,082 02	309,108 82	1,206,663 63	716,616 17
1838	3,493,061 54	351,023 15	9,308,120 41	446,798 88	1,640,070 19	843,247 87
1839	1,545,000 00	67,300 33	10,785,820 08	494,817 34	3,655,460 09	1,151,031 03
1840	3,478,553 90	137,726 22	14,126,647 76	658,921 58	5,005,515 75	1,031,806 70
1841	2,213,497 57	33,770 85	16,306,374 48	801,683 57	3,647,214 53	1,475,169 16
1842	3,411,618 00	143,600 03	19,574,392 45	1,006,497 81	2,599,116 81	1,154,879 50
1843	1,002,700 00	184,768 27	20,392,324 28	1,093,474 98	797,230 84	1,422,683 52
1844	655,000 00	333,418 60	20,713,905 58	1,116,726 53	712,449 53	1,751,599 62
1845	245,000 00	1,268,884 81	19,690,020 77	1,104,319 98	333,717 68	1,637,427 11
1846	300,000 00	2,961,780 64	17,028,240 13	976,552 48	182,367 30	2,159,496 75
1847	....	284,490 56	16,743,749 57	937,205 64	162,276 57	2,819,944 18
1848	1,314,819 34	1,344,919 00	16,713,649 91	911,736 05	864,767 36	2,301,117 74
1849	1,889,024 76	2,097,392 00	16,505,345 67	898,599 05	1,513,862 71	2,693,116 27
1850	192,595 49	482,786 64	16,215,144 52	868,873 74	2,132,370 93	2,557,115 56
1851	1,000,000 00	573,609 91	16,641,534 61	835,064 66	1,444,706 71	2,796,269 14
1852	700,000 00	340,265 45	17,001,269 16	843,795 62	1,381,254 63	2,125,811 57
1853	....	....	17,001,269 16	960,790 28	1,022,005 84	2,063,713 22
1854	2,250,000 00	479,025 00	18,772,244 16	926,231 51	1,156,024 74	1,744,248 77
1855	3,750,000 00	2,240,911 00	20,281,333 16	1,076,573 17	2,938,707 23	1,643,113 99
1856	6,750,000 00	4,489,266 34	22,542,066 82	1,194,306 62	4,011,241 22	1,935,107 23
1857	2,750,000 00	102,285 00	25,189,781 82	1,361,736 93	2,941,936 58	1,561,350 92
1858	2,200,000 00	2,929,767 34	24,460,014 48	1,406,120 80	1,942,658 43	993,325 97

1859	....	152,170 00	24,307,844 48	1,358,892 32	856,159 49	962,000 67
1860	3,900,000 00	1,100,523 00	27,107,321 48	1,472,745 78	3,264,976 23	1,669,611 61
1861	1,200,000 00	2,175,551 23	26,131,770 25	1,505,304 64	1,188,758 07	2,695,842 16
1862	....	2,120,000 00	24,011,770 25	1,429,859 36	1,264,078 51	4,081,591 35
Deduct the debt in 1835			6,328,056 19			
Increase of debt, 1836 to 1862			$17,683,714 06			
Paid interest, 1836 to 1862				$26,325,483 05		
Paid Canal Commissioners, 1836 to 1862					$48,843,151 82	
Amount of surplus revenues, 1836 to 1862						$49,118,093 93

STATEMENT,

Showing the various tonnage of the boats registered in each of the last sixteen years, and the progressive increase of their capacity.

TONNAGE.	Inventory of all boats to Jan. 1844.	NEW BOATS REGISTERED.																	
		1844	1845	1846	1847	1848	1849	1850	1851	1852	1853	1854	1855	1856	1857	1858	1859	1860	1861
250	......	......	......	......	......	......	......	......	......	......	3	1	......	1	1	1	2	2	16
240	......	......	......	......	......	......	......	......	......	......	1	......	1	2	......	......	......	......	7
220	......	......	......	......	......	......	......	......	......	......	1	1	......	......	......	......	......	3	55
200	......	......	......	......	......	......	......	......	......	......	5	3	4	......	3	3	4	33	176
180	......	......	......	......	......	......	......	......	......	......	......	......	......	4	......	7	12	60	51
170	......	......	......	......	......	......	......	......	1	......	......	1	......	......	......	15	7	17	[illegible]
150	......	......	......	......	......	......	......	2	......	1	6	13	2	2	51	46	11	14	27
140	......	......	......	......	......	......	......	......	......	......	......	......	......	4	15	5	1	2	19
135	......	......	......	......	......	......	......	......	......	......	......	......	......	5	2	......	......	2	1
130	......	......	......	......	......	......	1	......	1	2	7	9	43	22	16	4	2	2	3
125	......	......	......	......	......	......	......	......	1	......	18	105	18	14	21	15	1	5	6
120	......	......	......	......	......	......	1	......	2	......	16	143	125	118	84	13	9	22	15
115	......	......	......	......	......	......	......	......	......	......	10	34	17	13	4	......	......	5	1
110	......	......	......	......	......	......	......	......	......	......	16	87	13	10	6	3	1	4	6
105	......	......	......	......	......	......	......	......	......	......	......	......	......	1	2	......	2	......	......
100	......	......	......	......	......	......	2	13	27	34	79	83	28	28	8	25	14	55	69
95	......	......	1	1	6	......	4	6	23	63	180	69	40	38	18	15	5	13	20
90	2	1	4	6	27	10	4	25	72	90	164	95	58	69	43	16	36	42	42
85	1	......	1	1	45	21	13	16	11	22	22	20	16	3	16	5	8	35	30
80	3	9	13	100	560	143	78	38	28	26	33	44	28	6	15	22	25	49	37
75	14	33	60	186	553	158	75	17	22	10	15	32	43	17	14	14	21	19	[illegible]
70	175	124	107	123	162	59	20	20	18	9	6	10	23	4	3	7	16	4	7
65	295	94	54	26	44	13	2	4	1	4	3	1	2	......	1	3	4	3	2
60	526	71	33	9	30	25	7	3	2	2	2	2	4	......	3	18	8	2	6
55	256	15	4	1	13	8	......	......	......	......	......	......	......	......	......	......	10	......	......
50	457	14	5	3	4	2	2	4	1	6	3	1	3	1	......	7	1	2	2
45	158	1	2	1	3	4	......	......	1	......	......	1	......	......	......	1	3	1	......
40	148	......	......	3	4	1	......	3	1	......	......	1	......	1	1	3	......	1	1

35	33	1	1	......	3	......	......	......	1	......	......	......	......	......	......	......	......	1	......
30	34	11	1	2	3	6	4	......	......	......	......	......	......	......	1	......	......	......	......
25	10	3	......	4	3	......	......	......	......	......	......	1	1	......	......	3	......	......	1
20	8	......	3	3	2	......	2	......	......	......	......	......	1	1	......	......	......	2	1
15	3	1	......	......	1	1	......	......	......	......	......	2	1	1	......	1	1	......	......
10	4	......	1	2	3	1	......	......	......	2	......	......	......	1	1	1	1	2	......
5	......	......	4	......	......	......	......	1	......	......	......	......	......	......	......	1	1	1	......
2	......	......	3	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......
	2,126	378	297	477	1,466	457	215	152	213	271	590	760	471	364	329	255	206	403	619

N. B.—An allowance must, of course, be made of such boats as have gone out of use.

Accurate accounts were made of the number of boats on the first of January, in the years 1847, 1853 and 1859, and resulted as follows:

January 1, 1847, whole number of boats			2,725
January 1, 1853,	do	do	3,401
January 1, 1859,	do	do	3,867

TABLE *exhibiting the date of the opening and closing of the Hudson river, and the number of days open; also the time of commencement and close of each navigable season of canals, and the number of days of navigation since* 1824; *also the date of the opening of Lake Erie, since* 1827.

Opening and Closing of the Hudson River.			Commencement and Close of Navigation of Erie Canal.			Opening of the lake.
River open.	River closed.	Open days.	Canal open.	Canal closed.	Navigable days.	
March 3, 1824	Jan. 5, 1824	309	April 30, 1824	December 4	219	
March 6, 1825	Dec. 13, 1825	283	April 12, 1825	do 5	238	
Feb'y 25, 1826	Dec. 24, 1826	302	April 20, 1826	do 18	243	
March 20, 1827	Nov. 25, 1827	251	April 22, 1827	do 18	241	April 21, 1827
Feb'y 8, 1828	Dec. 23, 1828	220	March 27, 1828	do 20	269	April 1, 1828
April 1, 1829	Jan. 14, 1829	286	May 2, 1829	do 17	230	May 10, 1829
March 15, 1830	Dec. 25, 1830	283	April 20, 1830	do 17	242	May 5, 1830
March 15, 1831	Dec. 6, 1831	263	April 16, 1831	do 1	230	May 8, 1831
March 25, 1832	Dec. 21, 1832	289	April 25, 1832	do 21	241	April 27, 1832
March 21, 1833	Dec. 13, 1833	277	April 19, 1833	do 12	238	April 23, 1833
Feb'y 29, 1834	Dec. 15, 1834	291	April 17, 1834	do 12	240	April 6, 1834
March 25, 1835	Nov. 30, 1835	268	April 15, 1835	November 30	230	May 8, 1835
April 4, 1836	Dec. 7, 1836	248	April 25, 1836	do 26	216	April 27, 1836
March 27, 1837	Dec. 14, 1837	261	April 20, 1837	December 9	234	May 16, 1837
March 19, 1838	Nov. 25, 1838	257	April 12, 1838	November 25	228	March 31, 1838
March 25, 1839	Dec. 18, 1839	286	April 20, 1839	December 16	241	April 11, 1839
Feb'y 25, 1840	Dec. 5, 1840	285	April 20, 1840	do 9	228	April 27, 1840
March 24, 1841	Dec. 19, 1841	286	April 24, 1841	November 30	221	April 14, 1841
Feb'y 4, 1842	Nov. 28, 1842	308	April 20, 1842	do 28	222	March 7, 1842
April 13, 1843	Dec. 10, 1843	242	May 1, 1843	do 30	214	May 6, 1843
March 18, 1844	Dec. 17, 1844	278	April 18, 1844	do 26	222	March 14, 1844
Feb'y 24, 1845	Dec. 3, 1845	283	April 15, 1845	do 29	228	April 3, 1845
March 18, 1846	Dec. 14, 1846	275	April 16, 1846	do 25	224	April 11, 1846
April 7, 1847	Dec. 25, 1847	263	May 1, 1847	do 30	214	April 23, 1847
March 22, 1848	Dec. 27, 1848	292	May 1, 1848	December 9	223	April 9, 1848
March 19, 1849	Dec. 26, 1849	286	May 1, 1849	do 5	219	March 25, 1849
March 10, 1850	Dec. 17, 1850	282	April 22, 1850	do 11	234	March 25, 1850
Feb'y 25, 1851	Dec. 14, 1851	293	April 15, 1851	do 5	235	April 2, 1851

March 28, 1852	Dec. 23, 1852	270	April 20, 1852	do 16	239	April 20, 1852
March 23, 1853	Dec. 21, 1853	274	April 20, 1853	do 20	245	April 14, 1853
March 17, 1854	Dec. 8, 1854	266	May 1, 1854	do 3	217	April 29, 1854
March 27, 1855	Dec. 20, 1855	268	May 1, 1855	do 10	224	April 21, 1855
April 11, 1856	Dec. 14, 1856	248	May 5, 1856	do 4	214	May 2, 1856
Feb'y 27, 1857	Dec. 27, 1857	303	May 6, 1857	do 15	223	April 27, 1857
March 20, 1858	Dec. 17, 1858	273	April 28, 1858	do 8	225	April 15, 1858
March 13, 1859	Dec. 10, 1859	273	April 15, 1859	do 12	242	April 7, 1859
March 6, 1860	Dec. 14, 1860	283	April 25, 1860	do 12	232	April 17, 1860
March 5, 1861	Dec. 23, 1861	294	May 1, 1861	do 10	224	April 13, 1861
April 4, 1862	Dec. 19, 1862	259	May 1, 1862	do 10	224	

STATEMENT,

Showing, 1. *The amount of Tolls, (including rents from surplus waters) collected in each fiscal year, from* 1826 *to* 1862. 2. *Total sum paid to collectors, inspectors, and weigh masters, and the expenses of their offices.* 3. *The percentage of the cost of collection on the gross amount of Tolls collected.* 4. *The year in which the collection of Tolls commenced on each lateral canal.*

YEAR.	1. Tolls.	2. Cost of collection.	3. Per cent.	4. Name of canals.
1826...	$844,508 02	....	....	Cayuga and Seneca.
1827...	881,134 09	$275,086 61	$3 06	
1828...	831,002 10	31,095 20	3 73	Oswego.
1829...	817,919 28	32,171 04	3 91	
1830...	1,045,163 42	29,368 91	2 77	
1831...	751,268 62	27,686 13	3 72	
1832...	1,112,917 74	30,191 44	2 60	
1833...	1,388,380 53	32,474 33	2 30	
1834...	1,387,715 02	33,327 39	2 37	Chemung and Crooked Lake.
1835...	1,484,595 61	35,391 37	2 35	
1836...	1,598,455 48	35,275 62	2 19	
1837...	1,325,609 77	41,476 69	3 09	Chenango.
1838...	1,465,275 16	36,466 94	2 45	
1839...	1,655,788 56	53,329 85	3 20	
1840...	1,606,827 28	53,691 33	3 36	
1841...	1,989,686 71	53,247 08	2 66	Genesee Valley and Oneida Lake.
1842...	1,797,463 80	52,362 67	2 89	
1843...	1,953,829 08	47,065 05	2 40	
1844...	2,388,457 34	46,260 05	1 92	
1845...	2,375,533 43	47,423 69	1 98	
1846...	2,798,849 76	49,312 14	1 75	
1847...	3,463,710 26	50,759 55	1 47	
1848...	3,156,968 38	57,768 31	1 83	
1849...	3,378,920 18	56,706 62	1 68	
1850...	3,393,081 37	54,986 50	1 62	Black River.
1851...	3,703,999 34	75,358 45	2 03	
1852...	3,174,857 49	69,544 31	2 19	
1853...	3,162,190 14	70,460 42	2 22	Baldwinsville.
1854...	2,982,114 97	75,542 93	2 53	
1855...	2,632,906 11	79,846 49	3 03	
1856...	2,721,740 63	82,623 88	3 04	
1857...	2,531,804 38	83,046 94	3 28	
1858...	2,047,391 01	88,376 06	4 31	
1859...	1,814,362 47	69,582 93	3 84	
1860...	2,381,301 28	96,889 04	4 07	
1861...	3,358,033 97	70,456 85	2 10	
1862...	4,797,283 09	66,454 20	1 39	

STATEMENT,

Showing 1. *The tolls (including rents from surplus waters) received in each fiscal year, from* 1826 *to* 1862. 2. *The cost of repairs and collection of tolls.* 3. *The percentage which the cost of the maintenance of all the canals bears to the gross amount of tolls.* 4. *The aggregate tonnage of the total movement on all the canals, from* 1836, *when an account of tonnage was commenced, to* 1862.

YEAR.	1. Tolls collected.	2. Expenses of collection and repairs.	3. Per cent. of cost of maint'nance on tolls.	4. Tonnage of all canals.
1826	$844,508 02	$531,675 73	$62 95	....
1827	881,134 99	494,701 05	56 18	....
1828	831,002 10	393,517 99	47 41	....
1829	817,919 28	357,587 52	43 76	....
1830	1,045,163 42	292,673 76	28 03	....
1831*	751,268 62	224,419 83	29 82	....
1832	1,112,917 74	428,964 78	38 54	....
1833	1,388,380 53	487,797 32	35 15	....
1834	1,387,715 02	534,897 82	38 54	....
1835	1,484,595 61	510,524 76	34 41	....
1836	1,598,455 48	467,599 33	29 22	$1,310,807
1837	1,325,609 77	608,993 60	45 88	1,171,296
1838	1,465,275 16	622,027 29	42 42	1,333,011
1839	1,655,788 56	504,757 53	30 45	1,435,713
1840	1,606,827 28	575,020 58	35 80	1,416,046
1841	1,989,686 71	514,517 55	25 84	1,521,661
1842	1,797,463 80	642,584 30	35 72	1,236,931
1843	1,953,829 08	531,145 56	27 18	1,513,439
1844	2,388,457 34	636,857 72	26 63	1,816,586
1845	2,375,533 43	738,106 32	31 07	1,977,565
1846	2,798,849 76	639,353 01	22 83	2,268,662
1847	3,463,710 26	643,766 08	18 53	2,869,810
1848	3,156,968 38	855,850 64	27 11	2,796,230
1849	3,378,920 18	685,803 91	20 30	2,894,732
1850	3,393,081 87	835,965 81	24 64	3,076,617
1851	3,703,999 34	907,730 20	24 50	3,582,733
1852	3,174,857 49	1,049,045 92	33 04	3,862,441
1853	3,162,190 14	1,098,476 92	34 73	4,247,853
1854	2,982,114 97	1,237,866 20	41 51	4,165,862
1855	2,632,906 11	989,792 12	37 59	4,022,617
1856	2,721,740 63	786,633 40	28 90	4,116,082
1857	2,531,804 38	970,453 46	38 33	3,344,061
1858	2,047,391 01	1,078,878 91	52 69	3,665,192
1859	1,814,362 47	897,878 96	49 49	3,781,684
1860	2,381,301 28	746,976 78	31 33	4,650,214
1861	3,358,033 97	706,786 14	21 05	4,507,635
1862	4,797,283 09	773,398 32	16 12	....

The tonnage returns for 1862 are not all in, but may be seen in the report of "Tolls, Trade, and Tonnage," yet to be made by the Auditor.

* Nine months.

STATEMENT,

Showing the annual receipts, payments, remainders, and deficiencies under art. 7 *of the Constitution, commencing* 1*st October*, 1846, *to* 30*th September*, 1862.

Fiscal year.	Revenue, including interest on deposits.	Charges. Cost of repairs and collection of tolls.	To pay interest and principal of debt, and for support of government.	Total charges.	Remainder for completion of canals.
1847.....	$3,473,484 60	$641,650 08	$1,850,000 00	$2,491,650 08	$981,834 52
1848.....	3,204,070 16	855,850 64	1,850,000 00	2,705,850 64	498,219 52
1849.....	3,442,906 62	685,803 91	1,850,000 00	2,535,803 91	907,102,71
1850.....	3,486,172 30	835,965 81	1,850,000 00	2,685,965 81	800,206 49
1851.....	3,722,163 11	907,730 20	1,850,000 00	2,757,730 20	964,432 91
1852.....	3,179,145 78	1,049,045 92	1,850,000 00	2,899,045 92	280,099 86
1853.....	3,168,546 51	1,098,476 92	1,850,000 00	2,948,476 92	220,069 59
1854.....	2,988,665 21	1,237,866 20	1,750,799 01	2,988,665 21	†194,062 71
1855.....	2,639,792 12	989,792 12	1,650,000 00	2,639,792 12	†763,121 32
1856.....	2,749,133 40	786,633 40	1,962,500 00	2,749,133 40	†1,103,718 60
1857.....	2,559,469 06	970,453 46	1,589,015 60	2,559,469 06	†1,730,300 27
1858.....	2,072,204 88	1,078,878 91	993,325 97	2,072,204 88	†2,372,916 67
1859.....	1,859,879 63	897,878 96	962,000 67	1,859,879 63	†2,404,241 97
1860.....	2,416,588 39	746,976 78	1,669,611 61	2,416,588 39	†1,696,631 03
1861.....	3,402,628 30	706,786 14	2,695,842 16	3,402,628 30	670,400 48
1862.....	4,854,989 67	773,398 32	3,396,242 66	4,169,640 98	685,348 69
Revenue.	$49,219,839 74				
Cost of repairs and collection		$14,263,187 77			
To pay interest and principal of debt, &c..			$29,619,337 68		
Total charges				$43,882,525 45	
Remainder, as above, for completion of the canals, during the years 1847 to 1853, and 1862........................				$5,337,314 29	
Deficiencies, as above, during the years 1854 to 1861				10,935,393 05	
Balance of "remainder" for completion during 16 years					....

† Deficiencies.

List of State Engineers and Surveyors.

NAMES.	Served.		Remarks.
	From	To	
Charles B. Stuart..........	Jan. 1, 1848.	Dec. 31, 1849.	
Hezekiah C. Seymour......	Jan. 1, 1850.	Dec. 31, 1851.	
William J. McAlpine	Jan. 1, 1852.	Aug. 1, 1853.	Resigned.
Wheeler H. Bristol........			App'd Sept. 21, 1853. Declin'd.
Henry Ramsay............	Dec. 10, 1853.	Dec. 31, 1853.	Appointed to fill vacancy.
John T. Clark.............	Jan. 1, 1854.	Dec. 31, 1855.	
Silas Seymour............	Jan. 1, 1856.	Dec. 31, 1857.	
Van R. Richmond.........	Jan. 1, 1858.	Dec. 31, 1861.	
William B. Taylor.........	Jan. 1, 1862.		

Deputy State Engineers and Surveyors.

NAMES.	From	To	Remarks.
Francis H. Ruggles........	1857.	Dec. 31, 1857.	
George R. Perkins.........	Jan. 1, 1858.	Dec. 31, 1861.	
Sylvanus H. Sweet	Jan. 1, 1862.		

LIST *of all the Civil Engineers employed upon the New York State Canals, appointed by the Canal Commissioners and Canal Board, from* 1800 *to* 1862, *inclusive.*

NAME.	WHEN EMPLOYED.		RANK.
	From	To	
William Weston	1796	1808	Consulting engineer.
James Geddes	1808	1837	Principal do
Benjamin Wright	1817	1828	do do
Charles C. Broadhead	1817	......	do do
Lewis Garin	1817	1826	Engineer.
Canvass White	1817	1824	do
William Jerome	1817	1829	do
David S. Bates	1817	1827	do
Andrew A. Bartow	1817	1825	do
Valentine Gill	1817	1821	do
David Thomas	1817	1830	do
Marshall Lewis	1817	1821	do
Nathan S. Roberts	1818	1838	do
Caleb Hammill	1818	1821	do
Isaac Briggs	1818	1821	do
David Eddy	1822	......	do
Holmes Hutchinson	1819	1838	do
Davis Hurd	1822	1826	do
C. T. Whippo	1822	1827	do
John B. Jervis	1819	1838	do
H. G. Sargent	1824	1828	do
George W. Young	1819	1828	do
Alfred Barrett	1821	1837	do
B. H. Brown	1827	......	do
Noah Dennis	1827	1831	do
John Van Nortwick	1828	1830	do
Orville W. Childs	1828	1838	do
William Weller	1830	......	do
Frederick C. Mills	1830	1838	do
John T. Clark	1832	......	do
E. F. Johnson	1835	......	do
William J. McAlpine	1837	......	do
James Walker	1837	......	do
Timothy B. Jervis	1837	......	do
James Archbald	1837	......	do
Isaac W. Crane	1837	......	do
Portious R. Root	1837	......	do
Daniel Judson	1819	......	Assistant engineer.
William H. McElroy	1819	......	do do
Abraham Ogden	1819	......	do do

List of Civil Engineers.—Continued.

NAME.	When Employed. From	When Employed. To	RANK.
Hiram Tibbetts	1819	------	Assistant engineer.
H. Wright	1819	------	do do
J. Rice	1822	------	do do
John Bates	1825	------	do do
William J. McAlpine	1835	1837	do do
James Van Slyck	1833	------	do do
Henry S. Dexter	1835	1838	do do
William Peacock	1817	------	Surveyor, &c.
Andrew A. Ellicott	1817	------	do
Anthony M. Hoffman	1819	------	do
Aaron Vedder	1819	------	do
David H. Vance	1819	------	do
Thomas McElroy	1819	------	do
Jno. B. Jervis	1819	------	do
James Archbald	1837	------	Chief engineer.
John Hopkins	1838	------	do
Holmes Hutchinson	1835	1841	do
Orville W. Childs	1837	1849	do
Nathan S. Roberts	1835	1841	do
Alfred Barrett	1838	1843	do
Porteous R. Root	1836	1843	do
Frederick C. Mills	1835	1843	do
J. W. Crane	1838	1843	do
Joseph D. Allen	1840	1843	do
William J. McAlpine	1838	1846	Resident engineer.
Alfred Barrett	1837	------	do do
J. W. Crane	1837	------	do do
T. B. Jervis	1837	1841	do do
Van R. Richmond	1837	1849	do do
John Lathrop	1837	1843	do do
John Lathrop	1849	------	do do
L. H. Woodworth	1837	1840	do do
D. C. Jenne	1837	1840	do do
D. C. Jenne	1848	1850	do do
L. L. Nichols	1838	1840	do do
S. T. Holmes	1838	1840	do do
J. Amsden	1838	1840	do do
H. S. Dexter	1837	1842	do do
J. Van Nortwick	1837	1847	do do
H. P. Mills	1837	1842	do do
William H. Talcott	1838	1846	do do
William B. Vedder	1839	1847	do do

List of Civil Engineers.—Continued.

NAME.	WHEN EMPLOYED.		RANK.
	From	To	
Archibald C. Powell	1839	1846	Resident engineer.
Noadiah M. Childs	1839	1841	do do
Henry A. Farnum	1839	1843	do do
Gideon Frothingham	1839	1843	do do
Pelatiah Rawson	1839	1843	do do
Charles A. Olmsted	1837	1843	do do
A. J. Curtis	1840	1843	do do
J. B. Mills	1840	1843	do do
J. B. Mills	1849	......	do do
O. W. Storey	1837	1843	do do
O. W. Storey	1849	1862	do do
James Walker	1840	1843	do do
J. E. Cropsey	1840	1842	do do
E. Huntington	1840	......	do do
James Barnes	1841	1843	do do
James Barnes	1848	1850	do do
Erastus Hurd	1841	1843	do do
M. M. Hall	1841	1843	do do
John D. Fay	1841	1849	do do
E. H. Brodhead	1842	1847	do do
Gerrit Drake	1842	......	do do
D. Hardenburgh	1842	......	do do
H. Tracy	1842	......	do do
C. B. Evans	1842	......	do do
Alexander Campbell	1845	1850	do do
James O. Morse	1848	......	do do
Daniel Marsh	1848	1850	do do
Davis Hurd	1848	1850	do do
Charles W. Wentz	1848	1850	do do
Charles A. Olmsted	1850	1852	Division engineer.
John T. Clark	1850	1853	do do
Jerome B. Stillson	1850	1853	do do
Alexander Campbell	1852	......	do do
Van R. Richmond	1852	1857	do do
John D. Fay	1852	1854	do do
John D. Fay	1856	1861	do do
George Cole	1853	......	Acting division engineer
Daniel C. Jenne	1854	1857	Division do
Daniel C. Jenne	1862	......	do do
John Lathrop	1854	1856	do do
Charles W. Wentz	1855	1857	do do
J. P. Goodsell	1856	1861	do do

List of Civil Engineers.—Continued.

NAME.	When Employed.		RANK.
	From	To	
J. P. Goodsell	1862	......	Division engineer.
Orville C. Hartwell	1856	1859	do do
Henry Van Vleck	1858	1862	do do
William B. Taylor	1860	1862	do do
Orville W. Storey	1860	1862	do do
J. P. Goodsell	1850	1853	Resident engineer.
Daniel C. Jenne	1850	1853	do do
Orville W. Storey	1850	1853	do do
Orville W. Storey	1854	1857	do do
Orville W. Storey	1859	......	do do
John T. Clark	1850	1853	do do
James Barnes	1850	......	do do
Charles W. Wentz	1850	1853	do do
Charles W. Wentz	1854	1856	do do
Daniel Marsh	1850	1853	do do
Davis Hurd	1850	1852	do do
John Lathrop	1850	......	do do
John Lathrop	1853	......	do do
J. B. Mills	1850	......	do do
J. B. Stillson	1850	......	do do
L. L. Nichols	1851	1853	do do
Morris S. Kimball	1851	1862	do do
Francis F. Curry	1852	1855	do do
Orville C. Hartwell	1852	1855	do do
William B. Vedder	1852	1855	do do
Richard Vernam	1852	1860	do do
Thomas Evershed	1852	......	do do
George Cole	1852	1855	do do
William A. Perkins	1852	1855	do do
William B. Taylor	1854	1860	do do
M. C. Fremyre	1854	1859	do do
Ogden Edwards	1854	1857	do do
Ogden Edwards	1860	1862	do do
C. G. Voorhies	1854	1856	do do
Henry Van Vleck	1854	1856	do do
Theophilus Williams	1854	1857	do do
Edward Colman	1854	1856	do do
Spencer Cole	1855	1857	do do
John L. Stephenson	1855	1857	do do
Nelson J. Beach	1855	1857	do do
William H. H. Gere	1855	1857	do do
William H. H. Gere	1860	1862	do do

List of Civil Engineers.—Continued.

NAME.	WHEN EMPLOYED From	WHEN EMPLOYED To	RANK.
Stephen A. Charles	1856	......	Resident engineer.
William McCammon	1856	......	do do
Thomas H. Bates	1856	1858	do do
E. W. Butler	1856	1858	do do
E. W. Butler	1860	......	do do
Daniel Richmond	1856	1862	do do
Winslow L. Kidder	1856	1859	do do
Ensign Bennett	1856	1862	do do
H. V. B. Barker	1856	1861	do do
R. H. Colburn	1856	1858	do do
Hugh M. Severance	1856	1859	do do
George H. Clark	1857	1859	do do
William J. Keeler	1858	1862	do do
S. H. Sweet	1859	1861	do do
William B. Cooper	1861	1862	do do
George E. Gray	1850	1853	First assistant engineer.
Francis A. Utter	1850	1853	do do
Henry S. Dexter	1850	......	do do
L. L. Nichols	1850	1853	do do
L. L. Nichols	1855	1857	do do
J. S. Brown	1850	1853	do do
Orville C. Hartwell	1850	1853	do do
Morris S. Kimball	1850	1852	do do
Van R. Richmond	1850	......	do do
Theodore D. Judah	1850	1852	do do
Richard Vernam	1850	1853	do do
J. B. Stillson	1850	......	do do
Ethan C. Clark	1850	1854	do do
George D. Stillson	1850	......	do do
William Mullins	1850	1853	do do
William B. Taylor	1851	1853	do do
Octave Blanc	1851	1853	do do
John G. Sippell	1851	1853	do do
M. C. Fremyre	1851	1855	do do
Van R. Sweet	1851	......	do do
James Barnes	1851	1853	do do
John L. Stephenson	1851	1856	do do
Benjamin B. Hart	1851	1853	do do
Ely S. Parker	1851	1856	do do
Henry A. Smith	1851	1853	do do
Henry Ramsey	1852	1854	do do
William A. Perkins	1852	......	do do

List of Civil Engineers.—Continued.

NAME.	WHEN EMPLOYED.		RANK.	
	From	To		
D. C. Roberts	1852	......	First assistant	engineer.
Daniel Richmond	1852	1854	do	do
A. M. Leach	1852	1854	do	do
Edward Colman	1852	......	do	do
Stephen F. Gooding	1852	1854	do	do
Stephen F. Gooding	1856	1862	do	do
Joseph French	1852	1857	do	do
Samuel T. Wright	1852	......	do	do
W. D. Jones	1852	......	do	do
John L. Dodge	1853	1859	do	do
Egbert Bagg	1853	1856	do	do
Joseph W. Clark	1853	......	do	do
James P. Green	1854	1857	do	do
Robert Burns	1854	1857	do	do
Charles H. Beach	1854	1857	do	do
S. H. Sweet	1854	1860	do	do
W. S. Nearing	1854	1857	do	do
E. W. Butler	1854	1857	do	do
E. W. Butler	1861	......	do	do
James E. Willard	1854	1858	do	do
O. H. Bogardus	1854	1857	do	do
D. R. Hartwell	1854	1859	do	do
William B. Cooper	1854	1860	do	do
William H. H. Gere	1854	1856	do	do
W. W. Jerome	1854	1862	do	do
D. H. Ainsworth	1854	1856	do	do
Calvin Q. Newcombe	1854	1857	do	do
William Rumble	1854	1856	do	do
Hathaway Hurd	1854	1857	do	do
Stephen A. Charles	1854	1857	do	do
John Bisgood	1854	1856	do	do
Aug. M. Leach	1854	1856	do	do
Duncan Campbell	1855	1857	do	do
J. H. Ledlie	1855	1857	do	do
William Crooks	1855	1858	do	do
Thomas M. Sherman	1855	1860	do	do
Henry Pomeroy	1855	1858	do	do
Thomas Goodsell	1855	1860	do	do
William J. Keeler	1856	1859	do	do
J. A. Watkins	1856	......	do	do
R. D. Shephard	1856	1858	do	do
T. W. Spencer	1856	1858	do	do

List of Civil Engineers.—Continued.

NAME.	When Employed.		RANK.
	From	To	
H. H. Bates	1856	1858	First assistant engineer
Peter Hogan	1856	......	do do
Henry Petingale	1856	1859	do do
F. S. K. Russell	1856	......	do do
Charles F. Smith	1856	......	do do
M. Van Brocklin	1856	1858	do do
Howard Thompson	1856	1859	do do
A. McElroy	1856	1859	do do
C. B. Hyde	1856	1858	do do
B. M. Hanks	1856	1861	do do
H. C. Ruggles	1856	1861	do do
John A. Ditto	1856	1858	do do
A. C. Bishop	1856	1858	do do
Norman Seymour	1857	1859	do do
W. L. Campbell	1857	1859	do do
Oscar L. Wetmore	1857	1859	do do
J. A. Lighthall	1857	1859	do do
E. H. Crocker	1860	1862	do do
George Porter	1860	1862	do do
Engineers appointed pursuant to act, chap. 169, *Laws of* 1862.			
D. C. Jenne	1862	......	Engineer.
J. P. Goodsell	1862	......	do
O. W. Storey	1862	......	do
Wm. B. Cooper	1862	......	Assistant engineer.
M. S. Kimball	1862	......	do do
Ensign Bennett	1862	......	do do
W. W. Jerome	1862	......	do do

CANAL OFFICERS, from 1810 to 1862 inclusive.

Commissioners appointed by a Joint Resolution, passed March 15, 1810:

Gouverneur Morris, Stephen Van Rensselaer, DeWitt Clinton, Simeon De Witt, William North, Thomas Eddy, Peter B. Porter.

Commissioners appointed by Act passed April 8, 1811:

Gouverneur Morris, Stephen Van Rensselaer, DeWitt Clinton, Simeon De Witt, William North, Thomas Eddy, Peter B. Porter, Robert R. Livingston, Robert Fulton.

Commissioners appointed under Act passed April 17, *up to the organization of the Canal Board:*

Stephen Van Rensselaer, De Witt Clinton, Joseph Ellicott, Samuel Young, and Myron Holley, original Commissioners; Ephraim Hart, Henry Seymour, William C. Bouck.

CANAL BOARD, *established by Act, passed April* 18, 1826.

YEAR.	Lieutenant Governor.	Secretary of State.	Comptroller.	Treasurer.	Attorney General.	Surveyor General.	Canal Commissioners.					
1826	James Tallmadge	Azariah C. Flagg	William L. Marcy	Abraham Keyser	Samuel A. Talcott	Simeon De Witt	Stephen Van Rensselaer	Samuel Young	Henry Seymour	William C. Bouck		
1827	Nathaniel Pitcher	Azariah C. Flagg	William L. Marcy	Abraham Keyser	Samuel A. Talcott	Simeon De Witt	Stephen Van Rensselaer	Samuel Young	Henry Seymour	William C. Bouck		
1828	Peter R. Livingston and Charles Dayan	Azariah C. Flagg	William L. Marcy	Abraham Keyser	Samuel A. Talcott	Simeon De Witt	Stephen Van Rensselaer	Samuel Young	Henry Seymour	William C. Bouck		
1829	Enos T. Throop	Azariah C. Flagg	Silas Wright, Jr	Abraham Keyser	Greene C. Bronson	Simeon De Witt	Stephen Van Rensselaer	Samuel Young	Henry Seymour	William C. Bouck		
1830	William M. Oliver	Azariah C. Flagg	Silas Wright, Jr	Abraham Keyser	Greene C. Bronson	Simeon De Witt	Stephen Van Rensselaer	Samuel Young	Henry Seymour	William C. Bouck		
1831	Edward P. Livingston	Azariah C. Flagg	Silas Wright, Jr	Abraham Keyser	Greene C. Bronson	Simeon De Witt	Stephen Van Rensselaer	Samuel Young	William C. Bouck	Jonas Earll, Jr		
1832	Edward P. Livingston	Azariah C. Flagg	Silas Wright, Jr	Abraham Keyser	Greene C. Bronson	Simeon De Witt	Stephen Van Rensselaer	Samuel Young	William C. Bouck	Jonas Earll, Jr		
1833	John Tracy	John A. Dix	Azariah C. Flagg	Abraham Keyser	Greene C. Bronson	Simeon De Witt	Stephen Van Rensselaer	Samuel Young	William C. Bouck	Jonas Earll, Jr	Michael Hoffman	
1834	John Tracy	John A. Dix	Azariah C. Flagg	Abraham Keyser	Greene C. Bronson	Simeon De Witt	Stephen Van Rensselaer	Samuel Young	William C. Bouck	Jonas Earll, Jr	Michael Hoffman	
1835	John Tracy	John A. Dix	Azariah C. Flagg	Abraham Keyser	Greene C. Bronson	William Campbell	Stephen Van Rensselaer	William C. Bouck	Jonas Earll, Jr	Heman J. Redfield		
1836	John Tracy	John A. Dix	Azariah C. Flagg	Abraham Keyser	Samuel Beardsley	William Campbell	Stephen Van Rensselaer	William C. Bouck	Jonas Earll, Jr	John Bowman	William Baker	
1837	John Tracy	John A. Dix	Azariah C. Flagg	Abraham Keyser	Samuel Beardsley	William Campbell	Stephen Van Rensselaer	William C. Bouck	Jonas Earll, Jr	John Bowman	William Baker	
1838	John Tracy	John A. Dix	Azariah C. Flagg	Gamelial H. Barstow	Samuel Beardsley	Orville L. Holley	Stephen Van Rensselaer	William C. Bouck	Jonas Earll, Jr	John Bowman	William Baker	
1839	Luther Bradish	John C. Spencer	Bates Cook	Jacob Haight	Willis Hall	Orville L. Holley	William C. Bouck	Jonas Earll, Jr	William Baker	Samuel B. Ruggles		
1840	Luther Bradish	John C. Spencer	Bates Cook	Jacob Haight	Willis Hall	Orville L. Holley	Samuel B. Ruggles	Henry Hamilton	Asa Whitney	S. Newton Dexter	David Hudson	George H. Boughton
1841	Luther Bradish	John C. Spencer	John A. Collier	Jacob Haight	Willis Hall	Orville L. Holley	Samuel B. Ruggles	Henry Hamilton	Asa Whitney	S. Newton Dexter	David Hudson	George H. Boughton
1842	Luther Bradish	Samuel Young	Azariah C. Flagg	Thomas Farrington	George P. Barker	Nathaniel Jones	Jonas Earll, Jr	Daniel P. Bissell	Benjamin Enos	George W. Little	James Hooker	Stephen Clark
1843	Daniel S. Dickinson	Samuel Young	Azariah C. Flagg	Thomas Farrington	George P. Barker	Nathaniel Jones	Jonas Earll, Jr	Daniel P. Bissell	Benjamin Enos	George W. Little	James Hooker	
1844	Daniel S. Dickinson	Samuel Young	Azariah C. Flagg	Thomas Farrington	George P. Barker	Nathaniel Jones	Jonas Earll, Jr	Daniel P. Bissell	Benjamin Enos	George W. Little		
1845	Addison Gardiner	Nathaniel S. Benton	Azariah C. Flagg	Benjamin Enos	John Van Buren	Hugh Halsey	Jonas Earll, Jr	Daniel P. Bissell	Stephen Clark	Nathaniel Jones		
1846	Addison Gardiner	Nathaniel S. Benton	Azariah C. Flagg	Thomas Farrington	John Van Buren	Hugh Halsey	Daniel P. Bissell	Stephen Clark	Nathaniel Jones	John T. Hudson		
1847	Addison Gardiner	Nathaniel S. Benton	Azariah C. Flagg	Thomas Farrington	John Van Buren	Hugh Halsey	Daniel P. Bissell	Stephen Clark	John T. Hudson	Thomas Clowes		

CANAL BOARD ESTABLISHED BY THE CONSTITUTION, ADOPTED NOVEMBER 3D, 1846.

YEAR.	Lieutenant Governor.	Secretary of State.	Comptroller.	Treasurer.	Attorney General	State Engineer and Surveyor.	Canal Commissioners.		
1848	Hamilton Fish	Christopher Morgan	Millard Fillmore	Alvah Hunt	Ambrose L. Jordan	Charles B. Stuart	Charles Cook	Nelson J. Beach	Jacob Hinds.
1849	George W. Patterson	Christopher Morgan	Washington Hunt	Alvah Hunt	Ambrose L. Jordan	Charles B. Stuart	Nelson J. Beach	Jacob Hinds	Charles Cook.
1850	George W. Patterson	Christopher Morgan	Washington Hunt	Alvah Hunt	Levi S. Chatfield	Hezekiah C. Seymour	Jacob Hinds	Charles Cook	Frederick Follet.
1851	Sanford E. Church	Christopher Morgan	Philo C. Fuller	Alvah Hunt	Levi S. Chatfield	Hezekiah C. Seymour	Charles Cook	Frederick Follett	John C. Mather.
1852	Sanford E. Church	Henry S. Randall	John C. Wright	James M. Cook	Levi S. Chatfield	William J. Mc Alpine	Frederick Follett	John C. Mather	Henry Fitzhugh.
1853	Sanford E. Church	Henry S. Randall	John C. Wright	Benjamin Welsh	Levi S. Chatfield, and Gardner Stowe	Wm. J. Mc Alpine and Henry Ramsay	John C. Mather	Henry Fitzhugh	Frederick Follet.
1854	Sanford E. Church	Elias W. Leavenworth	James M. Cook	Elbridge G. Spaulding	Ogden Hoffman	John T. Clark	Henry Fitzhugh	Frederick Follett	Cornelius Gardiner.
1855	Henry J. Raymond	Elias W. Leavenworth	James M. Cook	Elbridge G. Spaulding	Ogden Hoffman	John T. Clark	Frederick Follett	Cornelius Gardiner	Henry Fitzhugh.
1856	Henry J. Raymond	Joel T. Headley	Lorenzo Burrows	Stephen Clark	Stephen B. Cushing	Silas Seymour	Cornelius Gardiner	Henry Fitzhugh	Samuel B. Whallon.
1857	Henry R. Selden	Joel T. Headley	Lorenzo Burrows	Stephen Clark	Stephen B. Cushing	Silas Seymour	Henry Fitzhugh	Samuel B. Whallon	Charles H. Sherrill.
1858	Henry R. Selden	Gideon J. Tucker	Sanford E. Church	Isaac V. Vanderpoel	Lyman Tremain	Van R. Richmond	Samuel B. Whallon, and Samuel B. Ruggles	Charles H. Sherrill	John M. Jaycox.
1859	Robert Campbell	Gideon J. Tucker	Sanford E. Church	Isaac V. Vanderpoel	Lyman Tremain	Van R. Richmond	Charles H. Sherrill	John M. Jaycox	Hiram Gardiner.
1860	Robert Campbell	David R. Floyd Jones	Robert Denniston	Philip Dorsheimer	Charles G. Myers	Van R. Richmond	John M. Jaycox	Hiram Gardiner	William I. Skinner.
1861	Robert Campbell	David R. Floyd Jones	Robert Denniston	Philip Dorsheimer	Charles G. Myers	Van R. Richmond	Hiram Gardiner	William I. Skinner	Benjamin F. Bruce.
1862	Robert Campbell	Horatio Ballard	Lucius Robinson	William B. Lewis	Daniel S. Dickinson	William B. Taylor	William I. Skinner	William W. Wright	Franklin A. Alberger.

S. E. & S. Rep

STATEMENT

Showing amounts expended by superintendents of repairs, and paid repair contractors, and average cost per mile, on each and all canals, from 1827 to 1862, inclusive.

YEARS.	Erie and Champlain canals.		Oswego canal.		Cayuga and Seneca canal.		Chemung canal.		Crooked Lake canal.		Chenango canal.		Genesee Valley canal.		Oneida Lake canal.		Black River canal.		Oneida River improvement.		Total miles.	Total cost of repairs.	Total average per mile.
	Cost of repairs.	Average per mile.	Cost of repairs.	Average per mile.	Cost of repairs.	Average per mile.	Cost of repairs.	Average per mile.	Cost of repairs.	Average per mile.	Cost of repairs.	Average per mile.	Cost of repairs.	Average per mile.	Cost of repairs.	Average per mile.	Cost of repairs.	Average per mile.	Cost of repairs.	Average per mile.			
1827	$232,472	$528	------	----	------	----	------	----	------	----	------	----	------	----	------	----	------	----	------	----	400	$232,473	$528
1828	225,846	513	$8,637	$329	------	----	------	----	------	----	------	----	------	----	------	----	------	----	------	----	478	234,433	490
1829	232,931	529	13,003	361	$8,499	$386	------	----	------	----	------	----	------	----	------	----	------	----	------	----	500	254,433	509
1830	202,968	461	12,500	349	5,477	247	------	----	------	----	------	----	------	----	------	----	------	----	------	----	500	221,005	442
1831	168,240	382	9,170	254	3,363	152	------	----	------	----	------	----	------	----	------	----	------	----	------	----	500	180,773	361
1832	327,302	743	12,259	340	5,356	243	------	----	------	----	------	----	------	----	------	----	------	----	------	----	500	344,917	690
1833	328,585	746	11,295	313	8,243	374	$24,666	$666	------	----	------	----	------	----	------	----	------	----	------	----	537	372,789	694
1834	429,659	976	12,181	338	8,832	401	25,639	692	$2,653	$331	------	----	------	----	------	----	------	----	------	----	545	478,964	879
1835	392,921	893	16,327	453	9,685	440	9,616	259	3,556	454	------	----	------	----	------	----	------	----	------	----	545	432,118	793
1836	310,183	704	51,637	1,434	29,898	1,358	9,665	261	4,739	592	------	----	------	----	------	----	------	----	------	----	545	406,122	745
1837	365,406	830	57,908	1,608	28,539	1,297	14,569	393	6,214	776	$19,508	$201	------	----	------	----	------	----	------	----	642	492,144	766
1838	374,713	851	49,360	1,371	18,994	861	13,394	364	4,454	556	10,809	214	------	----	------	----	------	----	------	----	642	481,774	750
1839	297,722	676	24,463	679	23,397	1,063	13,302	361	3,557	443	17,248	177	------	----	------	----	------	----	------	----	642	379,769	591
1840	364,292	827	34,796	915	24,740	1,124	12,401	335	4,501	562	15,427	159	$4,529	$125	------	----	------	----	------	----	694	460,686	664
1841	255,687	581	26,406	694	13,940	633	23,360	631	9,034	1,129	15,563	160	10,460	290	$3,370	$561	------	----	------	----	700	357,828	511
1842	322,354	732	31,427	827	15,829	719	34,524	933	8,113	1,014	18,955	195	17,749	341	3,608	601	------	----	------	----	700	452,559	646
1843	297,614	676	23,678	623	10,938	497	14,295	386	4,047	505	15,062	155	15,210	292	2,232	372	------	----	------	----	700	383,076	547
1844	371,449	844	28,598	752	14,442	656	12,703	344	3,951	493	15,959	164	15,556	299	1,636	272	------	----	------	----	700	464,329	663
1845	399,094	907	46,639	1,227	14,191	645	17,978	485	4,765	595	18,951	195	16,901	325	1,933	322	------	----	------	----	700	520,452	743
1846	371,185	843	53,546	1,409	12,325	560	14,264	385	5,309	663	18,452	190	17,399	334	17,875	2,979	------	----	------	----	700	510,355	729
1847	380,388	864	39,551	1,040	14,192	645	15,917	430	5,890	736	18,859	194	15,782	303	5,842	973	------	----	------	----	700	496,424	709
1848	503,953	1,145	72,783	2,021	13,009	591	27,232	736	8,516	1,064	20,901	215	26,577	510	1,855	309	------	----	------	----	700	674,777	964
1849	395,681	899	32,792	868	11,824	537	24,306	657	10,296	1,287	25,888	267	18,183	350	1,160	390	------	----	------	----	700	521,122	744
1850	478,887	1,085	31,805	837	10,831	492	33,230	852	5,620	905	27,189	280	18,575	357	4,892	815	$15,508	$398	$412	$21	762	626,950	823
1851	437,458	972	31,045	817	20,576	895	37,741	968	5,319	665	29,832	307	32,938	383	3,591	449	21,516	448	2,250	112	817	722,259	762
1852	558,329	1,232	42,728	1,124	27,606	1,200	32,620	836	7,751	969	36,730	375	79,587	904	6,360	1,060	30,731	667	2,084	104	887	824,533	929
1853	575,777	1,271	38,026	1,000	17,421	680	24,366	625	4,932	616	38,243	394	55,766	634	6,166	770	26,830	488	1,554	78	887	789,082	901
1854	677,270	1,543	86,529	2,277	17,025	680	30,653	786	5,132	641	49,187	507	48,093	546	10,440	1,740	28,548	570	3,255	162	887	960,265	1,082
1855	505,608	1,154	59,192	1,448	12,880	560	22,853	560	4,316	539	49,232	486	49,000	415	6,236	1,039	34,000	578	3,706	185	901	781,688	868
1856	454,865	1,031	59,854	1,574	9,364	448	17,209	441	3,647	456	13,903	143	34,271	381	2,589	432	17,204	441	2,482	124	901	616,014	684
1857	458,742	1,035	78,017	2,053	13,234	575	87,314	2,238	4,447	556	27,826	265	60,650	514	3,119	519	15,179	155	3,591	179	909	752,575	828
1858	435,916	973	107,698	2,834	21,769	946	105,605	3,862	9,803	1,225	44,114	455	80,911	686	4,104	586	18,622	190	2,797	140	917	878,721	958
1859	446,746	999	48,253	1,269	5,850	234	21,965	563	4,849	606	26,068	269	46,490	394	3,975	568	24,926	255	1,079	54	917	630,615	688
1860	229,008	526	15,639	412	3,492	159	12,431	319	4,598	575	26,934	278	38,518	304	4,059	676	22,287	237	------	----	866	356,966	412
1861	206,952	476	25,552	672	19,284	876	23,455	601	6,186	773	22,593	233	28,450	224	3,242	540	23,402	249	1,070	89	878	360,187	410
1862	230,650	533	31,192	725	19,059	657	27,024	692	7,557	933	29,086	299	64,711	534	2,475	353	23,629	241	450	22	924	342,817	371

Tons of property moved on each and all the canals, comprising the tons of total movement.

YEAR.	Erie.	Champlain.	Oswego.	Cayuga and Seneca.	Chemung.	Crooked Lake.	Chenango.	Genesee Valley.	Black River.	Oneida Lake.	Baldwinsville.	Total.
1837	667,151	261,659	161,353	20,274	20,288	24,258	8,[illegible]23	--------	--------	--------	--------	1,171,296
1838	744,848	266,553	222,697	23,541	30,256	30,336	14,[illegible]78	--------	--------	--------	--------	1,333,011
1839	845,007	263,552	221,014	26,300	36,089	26,823	16,928	--------	--------	--------	--------	1,435,713
1840	829,960	245,229	219,627	32,486	34,217	24,026	16,848	13,653	--------	--------	--------	1,416,046
1841	906,442	276,418	135,689	34,634	63,042	33,030	23,356	26,892	--------	22,150	--------	1,521,661
1842	712,310	230,844	129,498	31,716	54,866	18,660	17,177	41,860	--------	--------	--------	1,236,931
1843	819,216	262,212	240,571	25,998	66,247	31,856	19,026	48,313	--------	26,445	--------	1,513,439
1844	945,944	269,546	326,607	31,099	88,231	32,589	31,472	65,077	--------	25,991	--------	1,816,586
1845	1,038,700	266,922	340,481	46,464	114,740	39,489	38,305	73,546	--------	28,808	--------	1,977,565
1846	1,264,408	280,490	351,511	61,014	124,768	35,556	41,112	87,615	--------	22,188	--------	2,268,662
1847	1,661,575	313,124	441,096	58,204	189,165	36,318	44,051	95,632	--------	30,642	--------	2,869,810
1848	1,599,965	293,889	490,147	46,252	150,691	34,155	35,207	98,467	--------	47,451	--------	2,796,230
1849	1,622,444	321,345	557,637	40,440	135,867	36,317	36,557	84,674	--------	59,451	--------	2,894,732
1850	1,635,089	460,219	583,346	42,379	128,263	38,797	41,892	89,804	--------	56,828	--------	3,076,617
1851	1,955,265	513,793	676,321	37,084	159,563	29,309	40,307	100,722	25,320	45,049	--------	3,582,733
1852	2,129,334	531,001	684,191	47,275	187,577	35,757	44,939	122,901	36,497	43,969	--------	3,863,441
1853	2,196,308	608,354	761,276	58,973	249,980	53,985	76,538	157,164	41,924	43,351	--------	4,247,853
1854	2,224,008	602,913	611,533	72,995	270,978	25,349	77,142	158,942	55,525	34,532	31,945	4,165,862
1855	2,202,463	537,108	654,399	76,744	223,271	25,850	89,390	102,321	51,347	27,116	32,608	4,022,617
1856	2,107,678	611,610	657,381	131,907	245,621	28,559	105,502	113,731	68,126	18,485	27,481	4,116,082
1857	1,566,624	547,236	605,218	120,435	187,201	16,571	96,722	114,576	69,135	19,343	--------	3,344,061
1858	1,797,004	608,918	688,960	75,968	205,168	16,318	72,526	118,303	62,352	19,675	--------	3,665,192
1859	1,753,954	751,046	612,390	80,602	256,323	17,933	89,691	124,263	75,946	19,536	--------	3,781,684
1860	2,253,533	681,157	1,080,076	98,678	226,051	14,723	83,035	123,602	70,687	18,672	--------	4,650,214
1861	2,500,782	545,930	852,920	100,992	208,792	12,239	91,661	94,329	69,930	30,060	--------	4,507,635

NOTE.—Office at Baldwinsville abolished in 1857.

Tolls collected on and applicable or belonging to each canal, in each year, up to 1861.

YEAR.	Erie canal.	Champlain canal.	Oswego canal.	Cayuga and Seneca canal.	Chemung canal.	Crooked Lake canal.	Chenango canal.	Genesee Valley canal.	Oneida Lake canal.	Seneca River towing path.	Oneida River improvement.	Cayuga inlet.	Black River canal.	Baldwinsville canal.	Total.
1823	$199,655 08	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	$190,635 08
1824	294,546 62	$46,214 45	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	340,761 07
1825	482,664 23	73,615 20	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	566,279 49
1826	687,976 68	74,191 19	--------	$30,022 95	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	765,190 82
1827	775,919 22	83,341 02	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	859,260 24
1828	727,650 20	107,757 08	$2,757 67	279 70	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	838,444 65
1829	707,883 49	87,171 03	9,439 44	8,643 49	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	813,137 45
1830	943,545 35	89,053 79	12,335 18	11,987 81	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	1,056,922 12
1831	1,091,714 26	102,896 23	16,271 10	12,920 39	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	1,223,801 98
1832	1,085,012 28	110,191 95	19,768 20	13,893 04	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	1,229,483 47
1833	1,290,163 19	132,572 12	23,015 84	17,174 91	$694 00	$200 84	--------	--------	--------	--------	--------	--------	--------	--------	1,463,820 90
1834	1,180,967 56	115,211 90	22,168 02	18,030 95	3,378 43	1,473 40	--------	--------	--------	--------	--------	--------	--------	--------	1,341,329 96
1835	1,375,673 12	116,131 10	29,203 38	20,430 14	4,714 98	1,833 76	--------	--------	--------	--------	--------	--------	--------	--------	1,548,986 48
1836	1,440,539 87	115,425 24	30,469 83	20,523 43	5,066 20	2,311 86	--------	--------	--------	--------	--------	--------	--------	--------	1,614,336 43
1837	1,444,170 21	94,726 31	21,092 92	15,968 47	4,431 60	1,521 15	$10,812 72	--------	--------	--------	--------	--------	--------	--------	1,292,623 38
1838	1,414,174 21	104,125 15	27,372 38	18,397 47	4,394 63	2,016 32	20,430 87	--------	--------	--------	--------	--------	--------	--------	1,590,911 07
1839	1,427,031 53	113,753 69	34,162 42	18,747 47	5,187 27	1,721 31	15,778 33	--------	--------	--------	--------	--------	--------	--------	1,616,382 02
1840	1,597,334 46	102,427 74	29,522 93	18,848 57	4,958 41	1,723 53	14,001 53	$6,930 40	--------	--------	--------	--------	--------	--------	1,775,747 57
1841	1,813,650 58	117,841 14	38,244 22	23,583 37	9,396 42	2,017 32	18,815 48	9,927 69	$462 02	$844 58	--------	--------	--------	--------	1,034,882 82
1842	1,568,946 50	95,957 54	31,222 19	16,948 16	7,702 05	989 39	13,615 38	13,204 11	462 63	149 51	--------	--------	--------	--------	1,749,197 52
1843	1,880,314 55	102,308 50	36,203 93	19,417 38	9,762 56	1,327 18	16,194 75	15,291 78	507 74	296 80	--------	--------	--------	--------	2,081,590 17
1844	2,190,147 34	116,739 32	56,164 93	24,618 17	14,385 13	1,497 89	22,177 96	19,641 20	621 45	381 13	--------	--------	--------	--------	2,446,374 52
1845	2,361,884 24	119,210 41	58,347 05	22,520 14	21,444 53	1,952 73	26,521 75	23,173 93	653 53	473 52	--------	--------	--------	--------	2,646,181 87
1846	2,449,275 58	108,094 60	658,185 43	27,282 11	11,503 44	1,912 81	23,492 86	23,448 57	543 52	368 10	$14 52	--------	--------	--------	2,756,120 89
1847	3,333,347 36	120,097 80	77,933 34	28,925 95	16,677 70	1,946 50	28,570 33	26,707 25	624 74	372 96	176 07	--------	--------	--------	3,635,380 00
1848	2,947,881 76	117,500 60	79,793 22	28,814 20	16,191 25	1,821 70	32,272 80	26,722 12	688 97	469 72	236 89	--------	--------	--------	3,252,212 19
1849	2,962,132 09	121,672 00	91,220 39	27,192 71	15,781 34	1,796 04	21,295 45	25,567 42	821 06	274 82	239 71	$232 95	--------	--------	3,268,826 03
1850	2,993,125 93	133,969 43	98,528 42	26,739 89	15,997 74	1,696 75	19,908 72	27,675 95	3,683 62	270 42	9,483 14	189 14	$2,629 89	--------	3,273,899 22
1851	2,994,329 53	119,333 77	95,010 21	23,681 32	15,536 92	1,473 81	18,228 49	26,817 07	7,593 84	226 15	23,658 95	175 03	3,661 91	--------	3,329,727 09
1852	2,799,849 88	114,591 51	83,690 42	22,266 70	15,848 44	1,363 01	16,695 86	24,917 96	8,009 78	187 08	25,680 08	274 53	4,628 67	--------	3,118,244 02
1853	2,833,970 90	120,998 05	97,297 93	24,849 59	19,603 18	1,391 06	20,228 18	31,239 71	11,571 67	111 12	37,630 47	263 17	4,698 71	$864 25	3,204,717 99
1854	2,565,686 47	103,522 88	62,784 33	23,535 76	21,152 32	956 04	19,964 01	30,907 78	9,040 48	244 92	29,508 91	320 43	5,880 07	61 95	2,773,566 35
1855	2,589,272 27	106,524 67	82,121 52	22,918 83	19,768 42	1,080 65	20,036 66	25,546 98	7,012 21	271 90	23,200 69	352 21	6,897 92	71 17	2,805,076 10
1856	2,398,860 36	111,229 15	109,883 11	20,462 31	17,117 52	1,034 85	20,234 61	22,831 56	9,318 42	277 92	31,163 86	352 71	5,385 05	60 24	2,748,211 67
1857	1,769,179 01	104,889 99	82,665 63	16,565 34	15,516 51	635 36	19,568 71	25,203 81	1,265 53	145 99	3,546 37	313 81	6,131 57	13 12	2,045,640 75
1858	1,838,835 64	96,936 75	87,783 74	16,022 59	14,623 39	683 16	15,886 39	27,913 34	1,565 79	138 37	4,871 96	177 88	5,294 15	20 67	2,110,753 82
1859	1,457,584 62	106,361 91	71,406 02	17,072 66	16,918 95	631 55	18,273 45	27,855 51	320 23	142 16	1,040 16	184 48	6,129 65	23 62	1,723,944 97
1860	2,648,295 89	125,108 80	134,832 19	90,927 35	17,968 35	781 11	23,802 41	30,232 68	287 97	187 81	886 60	143 63	6,113 52	28 63	3,009,597 04
1861	3,589,133 69	91,824 15	135,453 60	18,509 22	15,506 77	609 46	25,381 79	23,806 30	210 92	229 89	1,127 88	143 96	6,827 88	19 30	3,908,784 81